the Petroleum Engineer

An International Monthly

JUNE • 1949

VOLUME XXI NUMBER 6

ALL DIVISIONS

The PETROLEUM ENGINEER Publishing Company

Irwin-Keasler Building

Dallas 1, Texas

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Extra Issue—The Reference Annual—July 1

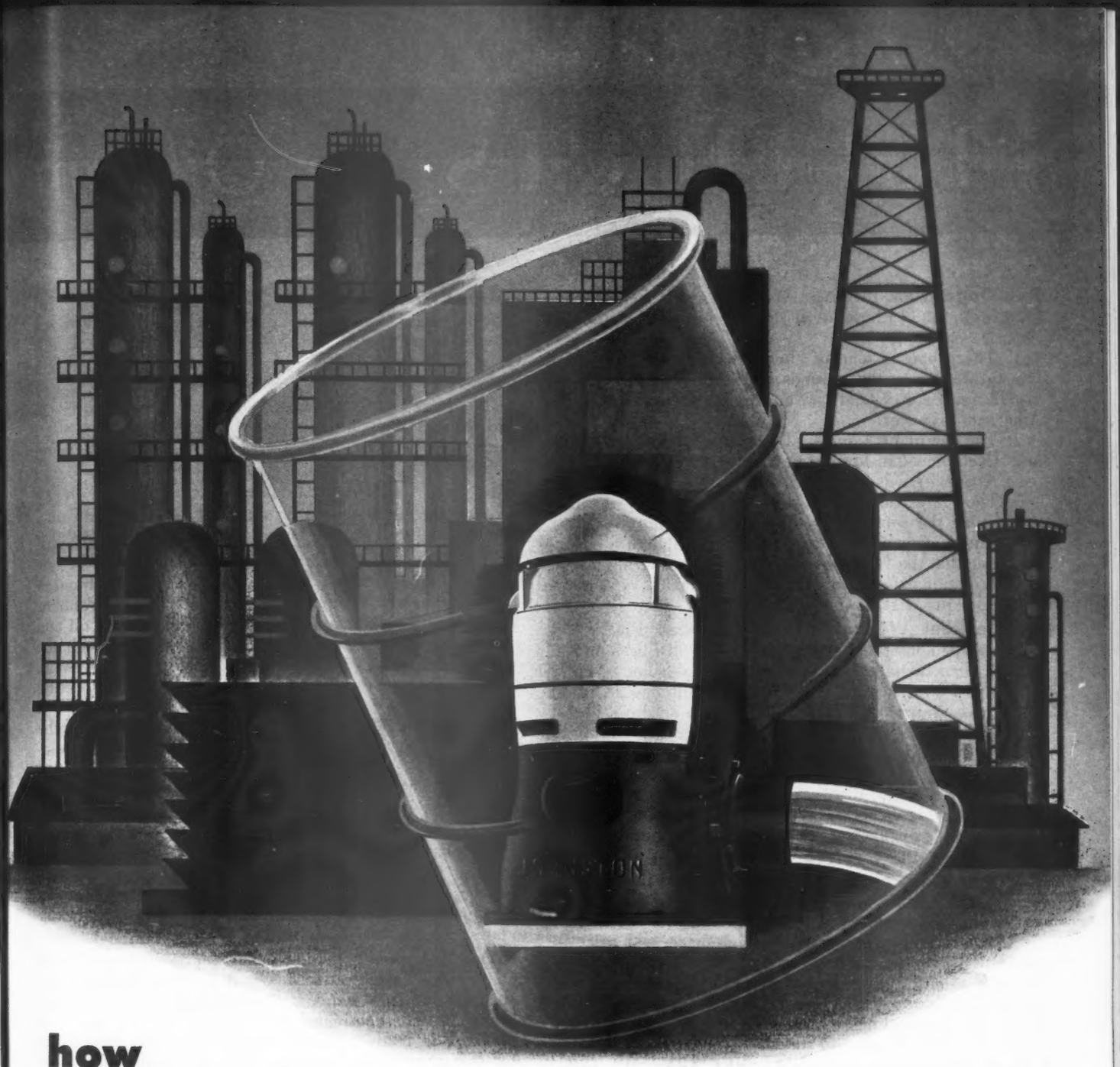
The Petroleum Engineer, published monthly, August through June, semi-monthly in July, by The Petroleum Engineer Publishing Company, Seventh Floor, Irwin-Keasler Building, Dallas, Texas. Subscription rate to the petroleum industry, United States and Foreign, $3.00 per year, $5.00 for two years; 25c a copy or back copies over 3 months old, 50 cents. Entered as second-class mail matter May 1, 1932 at the post office in Dallas, Texas, under the Act of March 3, 1879.

UNDISCOVERED OIL RESERVES

How much oil still remains to be discovered in the United States? On this question many dire predictions have been made. Are such predictions justified? Emphatically not, according to historical fact, for "throughout the history of our industry, expert opinion has consistently underestimated the aggregate volume of the petroleum resources of the United States. Because they have often been made by authorities of the highest prestige, these underestimates have been widely accepted. They have aroused periodic cries that 'we are running out of oil.' They have influenced government from time to time to propose measures which, if adopted, would seriously handicap the oil industry." Indeed the fact is, "we have already discovered some 64 billion barrels of oil in the territory which, according to the confident prediction of our highest authorities less than three decades past, would ultimately be found to contain a total resource of not more than 10 billion barrels. We have already found in the United States more than five times the amount of oil which our best minds fixed as the total ultimate resources of our country less than 30 years ago. Over the latter part of this period we have fought a World War in which we and our allies almost literally, 'floated to victory on a sea of oil.' Yet our proved reserves, which most of us have felt would surely be depleted in the face of our unprecedented consumption, have, instead, grown larger, and are now six times greater than the Federal Oil Conservation Board estimated them to be in 1926." Nevertheless, "This is the record upon the basis of which our administrative officials in Washington have from time to time concluded that 'we are running out of oil.' It should be clear from this that, in the past, our best estimates of total petroleum resources have been ultraconservative. To have relied upon them would have led us into grievous error."

It is not that our natural resources of oil are greater than those of other parts of the world. "We have found oil in the United States simply by drilling many tens of thousands of exploratory wells, on sites independently chosen by thousands of individual enterprises. . . . Central government planning, or an intelligently directed monopoly can discover large oil fields readily enough, under favorable conditions. But to discover hundreds of small, obscurely hidden and deeply buried oil fields, in one petroleum province after another, across the width of a continent, as we have done in the United States, can still only be accomplished, I think, by the method we have employed—the drilling of a great number of wells under the multiple direction of a host of diverse independent agencies, each following his own idea of where oil may be found." So, "In the light of our own experience, the failure of other nations to develop their own petroleum resources as fully and as rapidly as we have in the United States, becomes understandable." Oil being an exhaustible resource, we should therefore "be careful not to overestimate the volume of our petroleum resources. We should not permit or past failure to comprehend the magnitude of our petroleum resources to lead us now to the other extreme of concluding that they are inexhaustible." Our immediate problem is not the imminent exhaustion of petroleum resources. "Our problem is to develop fully our own petroleum resources and to maintain in a healthy and prosperous condition our own domestic petroleum industry in the midst of a world which faces at the moment, and seems likely for years to come to continue to face, a potential oversupply of oil."

The foregoing quoted statements, by no less an authority than Wallace E. Pratt, Vice President and Chief Geologist of the Standard Oil Company (N.J.), now retired, were made at a hearing in Dallas, Texas, of the Select Committee on Small Business of the House of Representatives of the federal government. They are well-founded observations by a recognized authority and are conspicuous by their very contrast with uttered opinions of others in high places less qualified to pass opinion on our potential undiscovered oil resources.—K. C. S.



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HIGHLIGHTS in Oildom

In Opposition. In three resolutions at the New Orleans meeting, the Independent Petroleum Association of America opposed:

1. The proposed loan of "hundreds of millions" of dollars to Mexico on the grounds that such loans are "ill-advised, unnecessary and an unwarranted burden on the American taxpayer."
2. The use of ECA funds abroad for "petroleum supply and development in foreign areas, beyond that required to meet recovery needs."
3. The unrestricted import of foreign oil "which is threatening the petroleum industry in this country."

Executive committee members declared that it was unthinkable that the U. S. government was considering a loan to help nationalize the oil industry in Mexico, a country that had expropriated American oil interests there.

Some Rank Wildcats Still Hit. Sinclair Prairie Oil Company demonstrated again that oil can still be found in unlikely places. Out in Borden County, Texas, some 40 miles from any production, the No. 1 Sterling Williams found oil in the Mississippi at 9830-78 ft and will go on down to test the Ellenburger. Nearest production is in Scurry County to the east, which has been the center of wide interest with its recent discoveries. W. L. Connelly, chairman of the board of Sinclair, said the discovery looks like it is really big. Whether it is big or not so big, it is another proof that there is a lot of wide open spaces that haven't been touched.

Reserves Follow Prices. Oil reserves can best be increased by higher prices for crude oil and redrilling in old areas, C. W. Tomlinson, president of American Association of Petroleum Geologists, stated at the mid-year meeting of the IPAA recently. He stressed the importance of price in connection with the discovery rate of oil reserves, and cited last year as an example. Twice as much oil was discovered last year as in previous years, and many more wells will be drilled this year and in the future as a result of 1948's higher crude oil prices, Tomlinson stated.

Underground Reservoir Sought. Approval is being sought by the Chicago Corporation to conduct a third Texas project on storing propane and butane inside a gas reservoir rather than above ground. Propane and butane, byproducts of oil and natural gas production, have had to be destroyed in the summer for lack of storage space, while the winter months have faced shortages. Industry observers believe this will solve the problem, as this fuel may be recovered in both liquid and gaseous state after injection into the reservoir. This third experimental project program is taking place in the Carthage field, Panola County, Texas.

Oil Demand Decreases. Domestic demands for oils have declined during the first quarter of 1949 according to a quarterly report by the Bureau of Mines. The report stated that the demand had averaged 5,878,000 bbl daily, or 2.2 per cent below the first quarter of 1948. Domestic demand for motor fuel gained 5.5 per cent over the 1948 period. Residual fuel oil demand declined 3.8 per cent, distillate fuel oil demand dropped, and kerosine demand was off 14.9 per cent. Daily crude production decreased 152,000 bbl to 5,224,000 bbl in March, according to the survey. This represented a decline of 464,000 bbl from the all time record of December, 1948.

Favor Flooding Wells. Members of the Osage Indian tribe have agreed to accept a lower royalty rate and insure a water-flooding project for the north Burbank field, Osage County, Oklahoma. The decision was reached by secret ballot, resulting in a vote of 1801 for to 709 against.

The project provides that oil companies operating in the field spend millions of dollars on the water-flooding project, which geologists and engineers estimate, will result in an additional recovery of more than 150,000,000 bbl of oil.

In turn, the companies proposed that the one-sixth royalty payment on production from the field be reduced to one-eighth after the sixth had been paid on the first 20,000,000 bbl of output.

Local Conservation Most Effective. No Washington strategist can have intimate knowledge of varying problems confronting individual states in the conservation of oil and gas, therefore primary responsibility should rest with the state government, is the opinion of Senator Andrew F. Schoepple of Kansas. Speaking before the quarterly meeting of the Interstate Oil Compact Commission, the senator added that the federal government does have its place in aiding the oil problem. In handling interstate commerce, in maintaining research, and in controlling imports of oil. He added that the public can best be served by the working together of the state and federal government, rather than on opposite sides.

Conferences on Tidelands. Officials of the coastal states were in Washington recently holding conferences with Speaker of the House Sam Rayburn, on tidelands legislation; however, nothing specific has been gained according to latest reports.

Texas, Louisiana, and California representatives met in an effort to decide how far they will give in to federal pressure for ownership and control of tidelands, but a no-compromise attitude dominated the meeting. Reports were that Louisiana is ready to make some concessions but Texas representatives were adament in their determination to hold out for complete control of the submerged coastal lands. California has already lost strict ownership of its tidelands through a Supreme Court decision to the effect that the federal government has "paramount rights." Congress must pass an enabling act, however, before federal operation can take over.

Proposes Curtailing Imports. Senator Elmer Thomas of Oklahoma has introduced an amendment to the reciprocal trade agreements act aimed at curtailing imports of foreign oil into the United States. The amendment provides that the President shall provide quotas on the importation of oil and products into the United States, thus limiting the importation of all petroleum to an amount not exceeding five per cent of the nation's domestic requirements.

Should the amendment become law, it would lower present imports about 50 per cent. In 1948 oil requirements averaged 5,800,000 bbl daily. Under the amendment the imports could reach about 290,000 bbl daily. At present oil imports average about 550,000 bbl daily.

Some oil men consider the Thomas amendment a part of the independent operators' program to cutback oil imports in line with demand.

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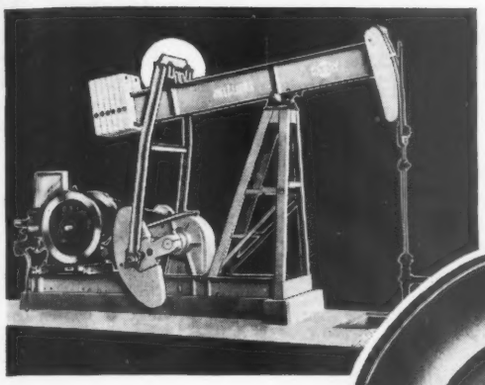

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Scanning WASHINGTON'S OIL HORIZON

By MILBURN PETTY

WASHINGTON—There is a good chance that Congress will act favorably on the two most important petroleum issues now pending—state control of tidelands oil development and exemption of independent gas producers from federal control—if congressional leaders succeed in placating a few die-hard but vociferous opponents.

Undoubtedly, a majority in Congress favors state control of the tidelands. But most of the Democrats, at least, could not vote to quitclaim this area to the adjoining states without flying in the face of President Truman's positive statement that these lands "must remain vested in the federal government."

▸ **Tidelands Problem.** The problem has been to work out some face-saving compromise, consistent with Truman's views yet avoiding the appearance of the states yielding any of their rights within the marginal sea (10½ miles out for Texas, 3 miles for other states). The Texas governor race—already started—complicates the situation.

Currently, the apparent solution is to postpone a showdown on the federal vs. state ownership issue, pending decisions in the Texas and Louisiana tidelands suits on which the Supreme Court has now given the "go ahead" signal to Attorney General Clark.

Meanwhile, the states would recognize that the federal government has "paramount rights" (whatever that means) in the offshore areas, the states to have control over oil development within the marginal belt and split the royalties with the federal government. Within the marginal belt, the states would receive about two-thirds of the royalties, the federal government, about one-third. Beyond this area, the percentages in the royalty split-up would be reversed.

▸ **Compromise Debated.** Some sort of compromise along these lines probably will come from hearings which Senator O'Mahoney's Interior Affairs Committee is expected to start soon. President Truman's final decision on the compromise, developed by O'Mahoney's committee, will depend on whether the die-hard opponents — both in Congress and among Truman's advisers—succeed in picturing it as "a sell-out to the oil interests." With both Democratic and Republican leaders backing such a compromise, however, the die-hards of both political parties might be persuaded to go along.

▸ **Gas Bill.** A similar situation exists with regard to the Harris-Lyle-Kerr bill exempting independent producers and gatherers of natural gas from jurisdiction of the Federal Power Commission. But here there are signs that a political deal has already been started. The Senate Commerce Committee has reversed its last year's action and voted 9-to-1 for confirmation of the appointment of Thomas C. Buchanan of Pennsylvania to the FPC. Now, if Leland Olds is appointed—and confirmed—the opponents of this bill may feel that the Olds-Buchanan-Draper majority in the FPC assures adequate protection for the consumer and back down on their opposition. So far, there has been some opposition to the gas bill in the newspapers (which friends of the bill have attributed to Olds' inspiration) but nothing like the whirlwind that was stirred up to beat the more comprehensive Moore-Rizley Bill last year. Olds' opposition to the bill has been regarded as a campaign for reappointment to the FPC. So, the gas bill's fate may depend on another Olds' term.

▸ **Prices.** Needled by the American Automobile Association, a Senate committee (headed by Senator Maybank, South Carolina) is going to investigate gasoline prices. A similar investigation by the Department of Justice is being sought. AAA's position is that gasoline price advances were unjustified in view of present conditions.

Meanwhile, the Department of Justice is continuing its investigation of complaints against successive reductions in Penn Grade crude oil prices. Through their congressmen, producers in this area have asked for an inquiry to determine whether there was concerted action by the crude purchasers in violation of the antitrust laws.

▸ **Alky-Gas.** The alcohol-gasoline issue is only a cloud on the horizon now—but watch it next year when the congressional elections are coming on. Also, next year's surpluses in most grain crops will be even larger than this year, with yields constantly improving and export markets shrinking. Alcohol as a motor fuel is one of the new uses for farm products being studied by a special committee of the Senate, headed by Senator Gillette, Iowa, with Paul Hadlick as committee counsel. (It was Hadlick who instigated the Madison Oil Case ten years ago as counsel for an oil jobbers association.) "Alky-gas" is being pushed by the U. S. Department of Agriculture as a means of conserving resources of petroleum and lead (because, it is claimed, using an alcohol injector permits the utilization of low octane motor fuels).

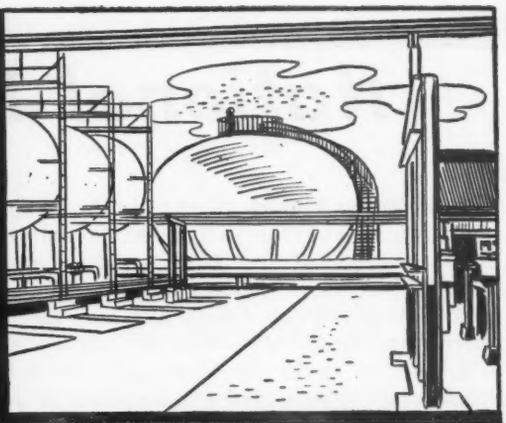
▸ **ECA.** Officials of the Economic Corporation Administration still insist that a cut will be made in European plans for expanding refinery capacity under the Marshall Plan—but the latest figures put out by the ECA still list the 1953 objective as 65.7 million tons of refining capacity, even though pointing out that this would exceed European estimates of demand then by more than 3 million tons and exceeds ECA's estimates by from 5 to 7 million tons. Before the war, Europe imported two-thirds of its requirements in the form of refined products. Now, these programs, being reviewed by ECA, would provide an exportable surplus.

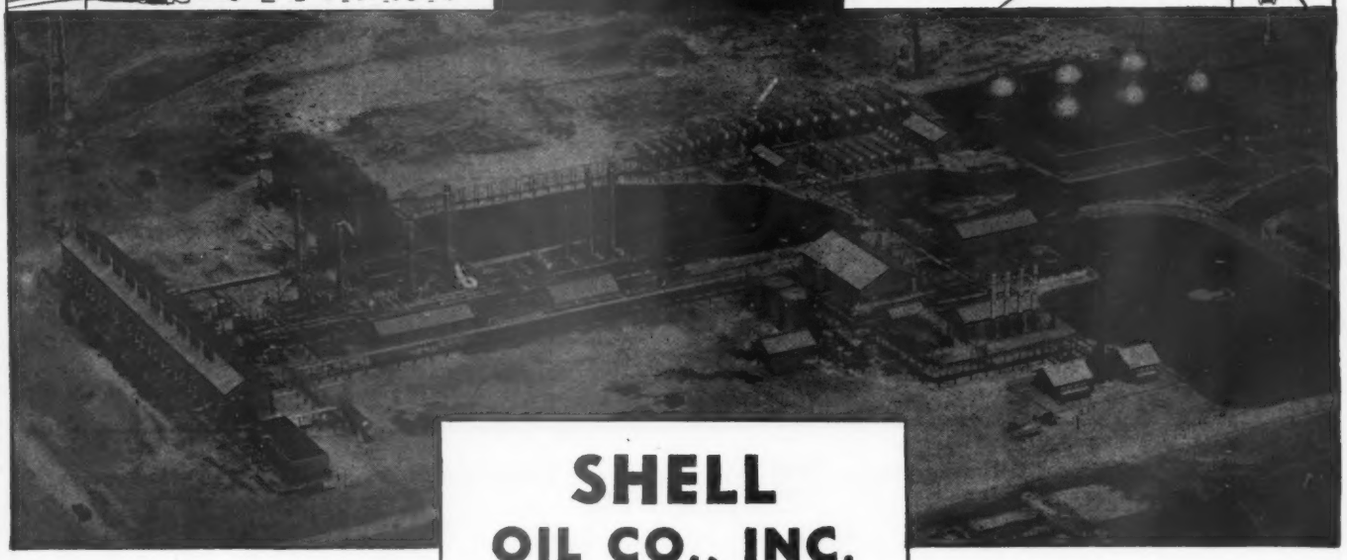
▸ **Transportation.** Pipe lines, barges, tank cars and trucks will be included in the comprehensive investigation of all land and water transportation by a special committee headed by Senator Myers, Pennsylvania. (Myers' announcement specifically listed pipe lines as being included.) All angles of "policy and operation" will be studied.

▸ **Imports.** Increasing use of foreign oil in this country, as shown by its rising percentage (about 7 per cent so far this year) of U. S. refinery runs, has spurred the Independent Petroleum Association of America to greater efforts in their campaign for restriction of imports—but, as Russell Brown, IPAA's general counsel says, it will be a long fight, perhaps two years more, he expects. Congressman Patman, Texas, expects to resume hearings here soon on oil imports, following a preliminary hearing at Dallas by his House Small Business Committee.

▸ **OGD.** National Petroleum Council is canvassing possible names to suggest for appointment as director of Interior's Oil and Gas Division, now that Acting Director Robert E. Friedman is resigning June 15 to join the Trunkline Gas Company as assistant to the president, Ralph K. Davies. Trunkline's 26-in. project from the Gulf Coast to Nebraska was recently approved by the FPC.

STORY OF A JOB





SHELL OIL CO., INC. TXL GASOLINE PLANT NOTREES, TEXAS

The best laid plans of men are frequently subjected to change by various influencing circumstances. Such was the case at Shell Oil Company's TXL Gasoline Plant near Odessa, Texas. Brown & Root, Inc., was awarded the contract to build a 30,000 mcf gasoline plant for Shell. During construction, new field development made it necessary to increase the throughput to 45,000 mcf. Shortly after completion, still further demands necessitated tripling the original capacity to handle 90,000 mcf!

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National Petroleum Situation

Stocks move higher. Stocks of all oils were increased in May by a total of more than 6,000,000 bbl. On May 31, total stocks of crude oil and refined products amounted to 613,147,000 bbl, which marks a gain over a year ago of more than 100,000,000 bbl. Efforts to reduce supply in May were more than offset by a substantially reduced demand for fuel oils. Fuel oil stocks are 37 per cent above last year, while stocks of all refined products are about 20 per cent greater. Present stocks are far above normal working levels and are exerting a weakening influence upon the industry's general price structure.

One bright spot. The gasoline market outlook is the one bright spot in the industry's immediate outlook. Demand in May, spurred by a three-day holiday, was about 4 per cent above April and total consumption in the first five months of this year was about 7 per cent above last year. With indications pointing to greatly increased gasoline consumption during the next 4 months, refiners are increasing gasoline yields and reducing their yields of fuel oils. Preliminary data indicate that May gasoline yields averaged about 45 per cent from crude, compared with 40.8 per cent a year ago. Fuel oil production has been reduced this year by about 6 per cent.

Effects of curtailment. Despite an increase in crude imports this year of nearly 40 per cent over last year, total crude supply in the first 5 months of this year was about 3 per cent below last year. Daily average supply, including increased foreign receipts of 116,000 bbl daily, was 105,000 bbl below last year. This was due to reductions in allowables, which cut the national crude output by 231,000 bbl daily. Texas cut-backs reduced crude production of this State by about 288,000 bbl daily under the cumulative average of last year. May production of Texas was 560,000 bbl below last year's daily average.

More wildcatting. In the face of reduced consumption and burdensome stocks, there has been no let-up in the search for new oil fields. Statistics of wildcat drilling operations indicate that such activity is greater than last year by about 15 per cent. In the first 5 months of this year, the industry drilled 2,633 wildcat wells, against 2,286 last year. Exploration has been particularly pronounced in Texas, California, Louisiana, and New Mexico.

Comparative Statistics, May, 1949

*All figures are computed on a Bureau of Mines' Basis**

	May 1949Ⓟ	April 1949Ⓟ	May 1948	This year to date	Last year to date	Per cent change
Total supply, all oils	183,920	180,442	197,458	933,909	953,985	— 2
Daily average	5,933	6,014	6,370	6,184	6,276	
Total demand‡, all oils	177,865	188,194	184,006	926,505	941,794	— 2
Daily average	5,738	6,273	5,936	6,135	6,196	
Change in stocks	+6,055	—7,752	+13,452	+7,404	+12,191	
Crude supply*	166,210	162,400	180,867	845,479	867,194	— 3
Daily average	5,361	5,413	5,834	5,600	5,705	
Crude demand‡	164,500	160,541	184,055	829,196	866,530	— 4
Daily average	5,307	5,351	5,937	5,491	5,700	
Crude stocks	272,910	271,200	231,318	272,910	231,318	+18
Days supply	51	50	39	51	39	
Natural gasoline production	13,000	13,030	12,044	63,859	59,329	+ 8
Daily average	419	434	390	422	390	
Motor fuel production	82,270	76,670	79,421	390,101	366,995	+ 6
Daily average	2,654	2,555	2,562	2,583	2,414	
Gasoline yield per cent	45.0	43.3	40.8	42.5	39.2	+3.3
Motor fuel demand‡	87,040	80,703	80,813	373,737	349,298	+ 7
Daily average	2,808	2,690	2,608	2,475	2,300	
Motor fuel stocks	118,640	123,410	108,552	118,640	108,552	+ 9
Days supply	42	45	41	42	41	
Fuel oil production	64,750	63,360	71,496	335,054	356,398	— 6
Daily average	2,088	2,112	2,306	2,218	2,345	
Fuel oil demand‡	56,400	67,233	66,283	375,676	401,475	— 6
Daily average	1,820	2,241	2,138	2,487	2,641	
Fuel oil stocks	121,890	108,240	89,299	121,890	89,299	+37
Days supply	67	49	41	67	41	
Refinery still runs	161,650	156,100	175,705	812,404	830,720	— 2
Daily average	5,214	5,203	5,668	5,380	5,465	
All refined stocks	340,237	335,892	281,673	340,237	281,673	+20
Days supply	59	54	48	59	48	

Current Crude Oil Prices

U. S. Average	$2.52	Louisiana	$2.62
Texas	2.61	Arkansas	2.43
California	2.42	New Mexico	2.40
Oklahoma	2.63	Mississippi	2.26
Kansas	2.62	Illinois	2.76
		Other states	2.60

Basic crude prices:

Oklahoma-Kansas (36 gr.)	$2.57
Texas Gulf Coast (36 gr.)	2.36
East Texas	2.65
West Texas (36 gr.)	2.44
California Signal Hill (26 gr.)	2.41
Pennsylvania, Bradford	3.27

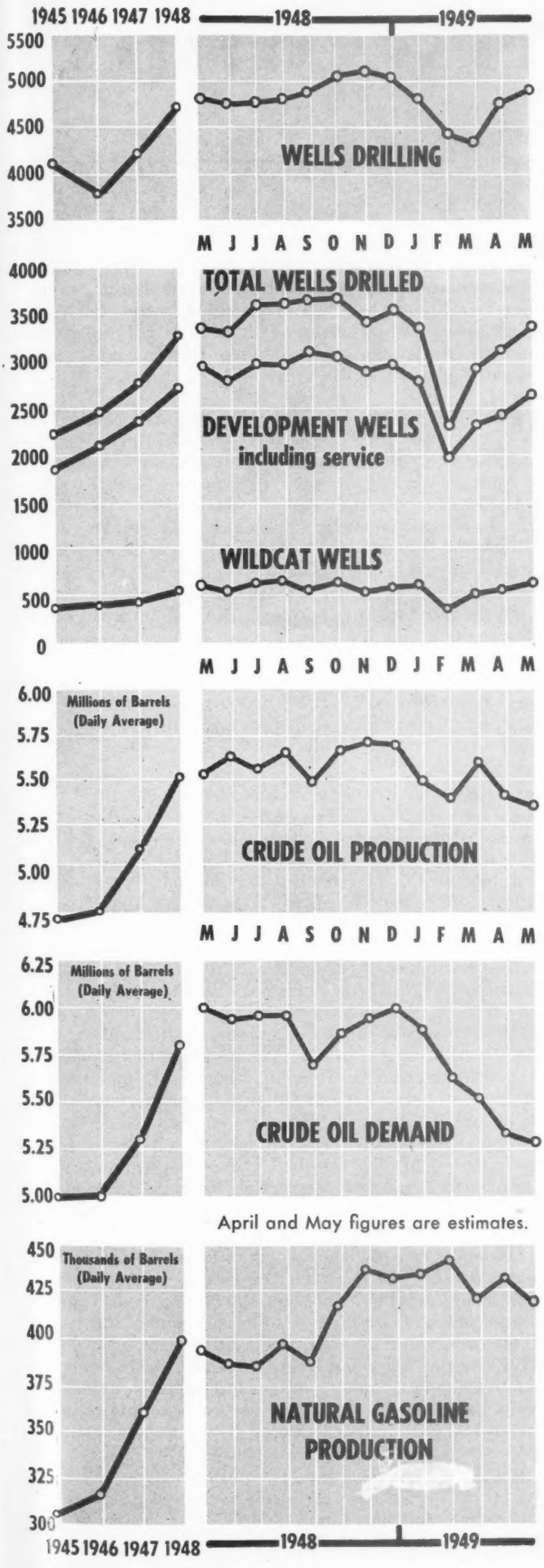
Drilling and Production Statistics

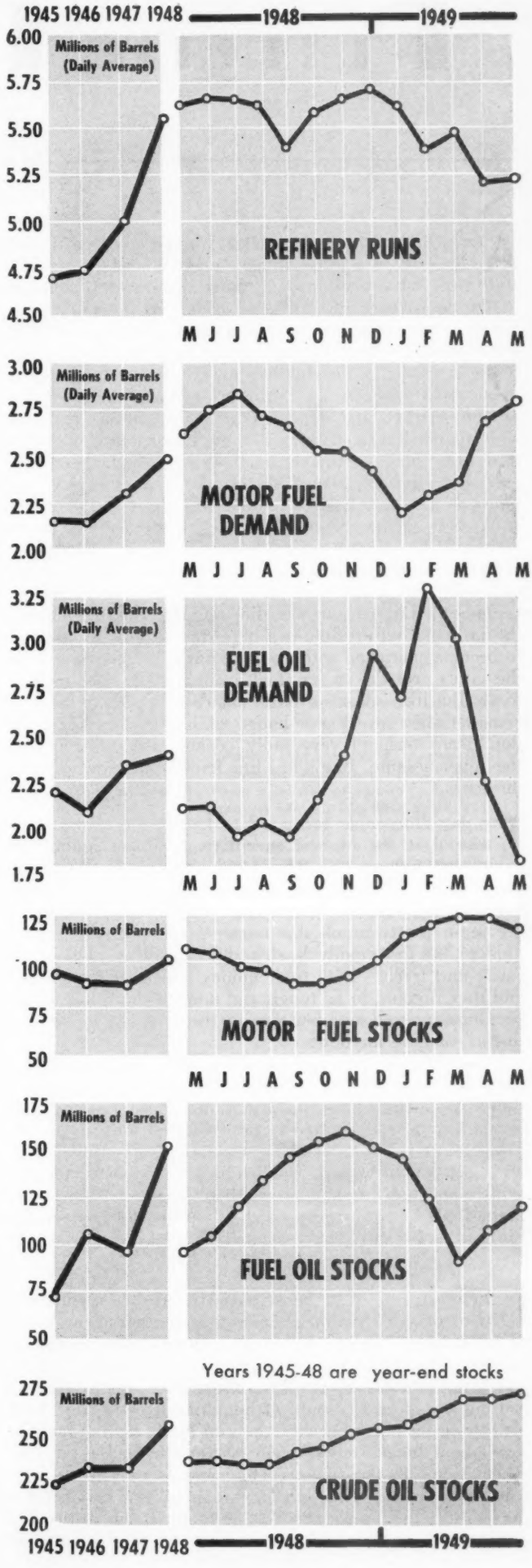
	May 1949Ⓟ	April 1949Ⓟ	May 1948	This year to date	Last year to date	Per cent change
Wells drilling	4,820	4,740	4,700	4,820	4,700	+ 3
Total wells drilled	3,389	3,147	3,384	15,143	14,339	+ 5
Development wells	2,650	2,460	2,661	11,939	11,183	+ 6
Oil	1,830	1,683	1,854	8,221	7,932	+ 4
Gas	250	224	201	1,083	907	+20
Dry	570	553	606	2,635	2,344	+12
Per cent dry	21.5	22.5	22.8	22.0	21.0	+1.0
Service wells	106	125	189	571	870	—34
Wildcat wells	633	562	534	2,633	2,286	+15
Oil	78	102	90	416	330	+26
Gas	11	13	18	62	102	—39
Dry	544	447	426	2,155	1,854	+16
Per cent dry	85.9	79.4	79.8	81.8	81.1	+0.7

By State

Wells drilled (excl service)	3,283	3,022	3,195	14,563	13,469	+ 8
Arkansas	34	37	27	126	126	0
California	218	221	264	1,061	1,156	— 8
Illinois	223	148	226	854	804	+ 6
Kansas	298	274	308	1,230	1,127	+ 9
Louisiana	164	143	220	830	821	+ 1
Mississippi	37	33	39	150	157	— 4
New Mexico	47	40	50	211	255	—17
Oklahoma	401	426	374	1,626	1,578	+ 3
Texas	1,227	1,049	1,030	5,484	4,463	+22
Other states	634	651	657	2,991	2,982	0
Wildcats drilled (incl. above)	633	562	534	2,633	2,286	+15
Arkansas	5	6	6	22	36	—39
California	37	34	38	202	145	+39
Illinois	48	27	31	148	140	+ 6
Kansas	50	29	51	193	176	+10
Louisiana	31	33	24	126	103	+22
Mississippi	14	3	8	44	38	+16
New Mexico	7	4	3	35	22	+59
Oklahoma	74	70	83	295	332	—11
Texas	289	270	217	1,226	964	+28
Other states	78	86	73	342	330	+ 4
Daily crude production	4,961	4,936	5,502	5,175	5,406	— 4
Arkansas	84	82	85	85	85	0
California	932	944	946	943	938	+ 1
Illinois	181	172	173	180	173	+ 4
Kansas	300	309	312	297	293	+ 1
Louisiana	522	509	492	517	481	+ 7
Mississippi	109	108	123	110	119	— 8
New Mexico	129	135	129	133	128	+ 4
Oklahoma	450	403	418	427	407	+ 5
Texas	1,894	1,940	2,454	2,129	2,417	—12
Wyoming	105	112	148	118	143	—18
Other states	255	222	222	216	222	— 3

*Unless otherwise stated all figures represent thousands of barrels. Ⓟ—Preliminary. *Includes domestic production and imports.
‡Total demand, including exports. Note—April and cumulative data revised to reflect changes in reporting by U. S. Bureau of Mines.
Preliminary estimates based upon data supplied by American Petroleum Institute, U. S. Bureau of Mines, State Agencies, and other official sources.


1945 1946 1947 1948
1948
1949
WELLS DRILLING
M J J A S O N D J F M A M
TOTAL WELLS DRILLED
DEVELOPMENT WELLS
including service
WILDCAT WELLS
CRUDE OIL PRODUCTION
Millions of Barrels
(Daily Average)
CRUDE OIL DEMAND
April and May figures are estimates.
Thousands of Barrels
(Daily Average)
NATURAL GASOLINE
PRODUCTION


1945 1946 1947 1948
1948
1949
Millions of Barrels
(Daily Average)
REFINERY RUNS
M J J A S O N D J F M A M
MOTOR FUEL
DEMAND
FUEL OIL
DEMAND
Millions of Barrels
MOTOR FUEL STOCKS
FUEL OIL STOCKS
Years 1945-48 are year-end stocks
CRUDE OIL STOCKS

PETROLIC PERSONALITIES

DICK SNEDDON

Almost since that moment when we first emerged from the chrysalis in a little village, called Wishaw, over in the tight little isle—Scotland—we have been acutely conscious of the importance of oil in the scheme of things. We were barely able to toddle a shaky way from place to place, when we were called upon by custom and convention to schedule periodic trips to a nearby dispensary, for a can of what we then called "paraffin ile," with strong Caledonian emphasis on the one "r" and almost total neglect of the two "f's." This oil, used as an illuminant in our house lamps, we believe now, must have been a shale oil. It stank with that persistence and odoriferousness which, Joe Scanlon says, "would nauseate a vulture," and it tainted everything and everybody it came in contact with. All grocery shops carried it, and consequently all groceries smelled of it—and tasted of it.

In due course we graduated from the messenger boy stage of our education and were given the higher responsibility of keeping the lamp reservoirs filled and the wicks trimmed. In the carrying out of these two important chores we managed to become encrusted with a sort of paraffin epidermis which, the saints preserve us, we shall probably bear with us to the tomb. But like callouses on the hands of a pick swinger, we consider this covering a badge of honor, and maybe we don't want to shed it very badly, because after all it has been the "open sesame" to a lot of fine friendships down through the years.

The petrolic people are good to know! From the lowest menial to the highest executive, we have found them completely human, and there is something very comforting about being of them and accepted by them. They are a transient lot, but no matter where you find them they are in the main pretty much the same—gruff, outspoken, great kidders, but thoroughly clean and decent inside. They spend easily and freely—both their money and their sympathy—and they pretend to be tough and unemotional, but we suspect they can well up a few tears in the dark of a movie show just as easily as anybody.

Exemplifying the facility with which they move from place we have just remembered that Bramston Cook and Bob Stirton, two of our old workmates in Wilmington, California, are now associated in the Oronite Company in New York. "Cookie" is an erstwhile Canuck who could easily be mistaken for an Oxford Englishman. He is very much the gentleman, and has had a wealth of experience in the exploitation of petrolic process discoveries. Bob Stirton is a Ph.D. who is plenty sharp at making the kind of discovery that Cookie exploits.

Incidentally, one of the most recently enrolled members of Petroleum Production Pioneers, is another New Yorker of substance—James Alexander Dunn—who became attached to Barnsdall Oil Company away back yonder in 1904, and being now president of that illustrious organization has run out of ladder to climb. Although he lives in New York, Mr. Dunn spends what time he can spare at his beautiful Tar Island home, across from Alexandria in the St. Lawrence River, in the famous Thousand Islands area. Here, when he is not swinging an unfortunate pike or a pickerel on the end of a fishing rod, he may be found at one of the local golf courses swinging a nasty niblick at an obstinate golf ball. He is president of the Golf Club in the Alexandria Bay area.

Meantime, out in California, down Temple City way, his daughter—Jane—has been thoroughly acclimated to the winter snows, while her husband, Michael J. Prejean, from our old stamping ground, Hamilton, Ontario, takes care of employe relations for Barnsdall.

We have thought seriously of dropping a note to Bill Farrand, the Texas executive in New York, and another member of the Petroleum Production Pioneers, asking him to call a meeting of the New York chapter. Even if we have only two members, they are pretty high caliber people, and who knows maybe they could sign up Mayor O'Dwyer and a Rockefeller or two to add further prestige to the order. It perhaps should be made clear, by the way, that although Bill Farrand is now regarded as a dyed-in-the-wool New Yorker, and probably by this time speaks with a 42nd Street accent, he is really a California boy at heart. We can remember full well having lunch with Bill, George Gosline, and Cy Rubel, up in a Santa Paula cafe many years ago. At that time Bill was superintendent for The Texas Company up in the Ventura area; George Gosline had the same job for Union; and Cy was director of production for Union—on a tour of inspection.

George, who was a topshot mechanic, had an old well pulling machine out in the yard and was converting it into a washing machine or something. In any case, he cut it apart with a cutting torch and welded it together again in a way that impressed this mechanical sissy no end. He had a built-in bedroom in the rear of his car before Nash ever thought of it and had made more gadgets and contrivances than General Motors. Perhaps that explains where son, Jim, now assistant manager of production for Standard of Cal at San Francisco, acquired some of his mechanical genius.

In a copy of MacMillan's Magazine, dated January 1885, from the library of Johnny Abrams, Long Beach operator, we note among other items an intensely interesting article by our former compatriot and fellow millionaire, Andrew Carnegie, late of Pittsburgh. The piece is about the oil and gas fields of Pennsylvania, and besides proving the steel magnate's powers of observation, it proves that he was a pretty sharp scribe. Andy, as we used to call him—although he never knew it—had made a trip to Storey Farm on Oil Creek in 1863, and had purchased the farm for $40,000.

Conservation conscious oil men of today will wince at the *modus operandi* of the gathering system on this lease. An open sump, capable of holding 100,000 barrels of oil was constructed, and was believed to be sufficiently large to hold all the property would ever produce. However, according to Mr. Carnegie, "the pond leaked fearfully; evaporation also caused much loss, but we continued to run oil in to make the losses good day by day, until several hundred thousand barrels had gone in this fashion."

Despite this loss, in the years between 1863 and 1885 the Storey Farm rose in value to five million dollars; and in one year alone it paid cash dividends exceeding a million dollars, which, said the astute Andrew, was "rather a good return on a $40,000 investment."

Willingness to work with foresighted engineers and operators in their plans for equipment to meet expected but-as-yet unexisting conditions . . . ability to design and produce that equipment . . . plus the reputation established through more than a decade of service . . . these are the reasons why W-K-M VALVES were specified on this immense Christmas Tree. It's the largest and heaviest ever built . . . designed for working pressures of 10,000 POUNDS PER SQUARE INCH!

True, 10,000 pound pressures have not yet been encountered, but when they are, W-K-M ALREADY HAS THE VALVES TO HANDLE THEM. And when still heavier equipment is required, you may rest assured that W-K-M will again have it ready.

20,000 pound test Christmas Tree, equipped 100% with W-K-M Valves, on display at Cameron Iron Works, Houston, Texas.

W-K-M Company, Inc.

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HOUSTON, TEXAS, U. S. A.
LOS ANGELES

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Export Office: 30 Rockefeller Plaza, New York, N. Y.

Included in the parcel from Johnny Abrams was a copy of the New York Daily Graphic, dated January 15, 1878, in which his father, E. E. Abrams, writing under the pen name of Van Winkle, had done an excellent piece on the town of Bradford as it was at that time. The population was 7000, and here is what he has to say about business: "Business is simply immense. During one month, prominent dealers in oil well supplies, such as engines, boilers, tubing and casing, sold to the amount of $400,000. In speaking with the agent of a wholesale firm, he said, 'Here is $70,000 in checks and paper collected in three days.' A dealer in domestic hardware disposed of 200 stoves in a week. Dry goods trade is extensively carried on. The stores are large and filled up in city style. A graduate from Claffin's has a large storeroom filled with a choice stock. He has 15 clerks who sell lace curtains worth $50 a window, and sealskin sets at $300. His cash boys are kept busy."

Johnny Abrams is himself something of a pioneer oil man. Both his grandfather and father were among the earliest Pennsylvania operators, and they used to take him with them as they scouted the country either for oil or oil news, so while still very young he fell a victim of the petrolic virus. He was educated at Washington and Jefferson College in Pa., and M.I.T. at Boston. After a long stint with the AEF in World War I, he was associated with E. J. Miley, and Joseph B. Dabney. Since then he has been operating in his own name in a number of western fields, and for a time acted in behalf of the John Hays Hammond interests, developing heavy crude production at Oxnard, California.

In his spare moments he just naturally packs in to some distant and difficult trout stream, and on such jaunts is usually accompanied by Mrs. Abrams. Not only does Mrs. Abrams accompany him, indeed—she paces him, and he has to work his head off to keep up with her. As Jimmy Durante says, "It's shumiliatin!" Anyway, they both enjoy getting to the mountain streams almost as much as they like to fish in them, so the arrangement makes for some mighty nice times together.

New Yorkers are certainly in the news this month. We are advised by our bridge operative in Tulsa, Oklahoma, that one of the greatest proponents of the Culbertson system thereabouts is Joe Kennedy, division engineer, Sinclair-Prairie Oil Company, a well known New Yorker who developed his aptness with the colored pasteboards at Colorado School of Mines, between geology lectures. The way we hear it, Joe can give east and west their pick of the deck and still win the rubber before they have finished aranging their cards.

Away from his bridge he occupied himself for a number of years in the Sinclair geological department around Ardmore and Shawnee, Oklahoma, and was finally transferred to the production department at Midland, Texas, as division engineer. Then came a spell in the U. S. Navy, after which he returned to Tulsa and his present post. Despite Joe's rising repute as an accumulator of quick tricks, he takes more pride in the fact that he has earned a private flyer's license —and now the slightest thing makes him soar. Huh! He is also terrifically proud of a neat little family, consisting of two junior pilots and an embryo stewardess, ranging in age from 8 years to 8 months.

Still confining ourself to the New York area, we are informed somewhat surreptitiously, if we may wax polysyllabic, that Mr. and Mrs. Harry Morehouse, a pair of consequential Angelenos, recently flew with Mr. and Mrs. Val Wittich, Jr., a substantial duo from New Amsterdam, to Bermuda. There they basked in the sunshine and drank in great drafts of ozone; bicycled from hither to yon; and listened entranced to the pronounced English accent of the colored people. Buoyed up no end by this exemplary behaviour, they eventually had to return to New York to clean up the unfinished business left by Mr. and Mrs. Charlie Wagner.

The latter had been on a business trip to the metropolis but had found it necessary to dash back to Balboa, the Bermuda of the West Coast, when the bottled California climate they always take with them looked as if it might run out. At the present time, there is every indication that this sextet has completely returned to its normal status. Wagner Morehouse is doing business at the old stand with both principals in constant attendance, and Val Wittich is back at Rockefeller Plaza, resting his bicycle muscles, and hoping that some day he will again be able to use them for playing golf.

Ed Millett, Jr., the personable secretary of the California Natural Gasoline Association, has been elected district governor of District 4, Lions International. He will be officially installed at the International Convention in New York City on July 18, 1949. His home club is Venice, California.

Verne "Mitch" Mitchell, enthusiastic disciple of Securaloy, is off on a protracted trip to the South Americas. It should be a sort of home coming for Mitch. He seems to know and be known by everyone who ever comes north for a visit from any of the oil areas below the border.

Had lunch with Herb Eggleston, General Petroleum's refining and gas processing expert. His dad was a production chief for Standard of New Jersey and lived for some time in Rumania, where Herb became quite a buddy of Prince Carol.

We hear that Jerry Rusk, an old fraternity brother, did an excellent job for G. P. during the past years as chairman of the Foreman's Club. We ain't surprised. Jerry always was a good organizer.

Fritz Ripley, the Ideco chappie from Torrance, showed up at the Pioneers' barbecue with such a train of New Yorkers, it looked as if he were going on safari. Haven't got the lowdown on this delegation yet but will report later.

Bill Kinder, the good looking Emsconian is back home briefly after a tour of the Mid-Continent.

Incidentally, Hugh Glen, the Emsco prexy, is a guitarist of no mean order. Besides strumming the instrument with a rare artistry, he thumps his right foot just as expertly as any trained hillbilly.

Chris Christanelli, the Baroid bard from Houston, is rapidly becoming the indispensable man at California oil men's functions. Chris has a grand singing voice, lots of personality, and a concertina from which he can coax the cutest music you ever heard. Seems funny though that such a big strong man should need a shelf to support the instrument!

Remember, gasoline that doesn't knock is a product of crude from contented wells.

E. O. Dunaway has been named department agent of the refining department of The Texas Company to succeed F. C. Jones, who is retiring after 39 years of service.

Jones, a native of Paola, Kansas, where he started his oil career, has been Texaco's refining department agent for the past 20 years. His first job was in a bank in his home town. He became an oil company cashier after several years and in 1910 joined The Texas Company at Houston, Texas. A devoted gardener, Jones is a member of the Men's Garden Club of Houston, and is currently president of the Houston Amaryllis and Bulb Society.

In succeeding Jones, Dunaway steps up from his post as assistant agent for Texaco's refining department. Dunaway has been a Texaco employe for 27 years, with the exception of an interim year spent with another company. He was born near Brewers, Kentucky, in 1899 and attended both Simmons College (now Hardin-Simmons University) and the University of Texas.

WORLD PETROLEUM BALANCE SHEET, 1947

(Thousands of barrels daily)

	Crude oil production	Nat gaso, benzol, synthetics, etc	Total production	Imports from other major areas	Total supply	Stock change‡	Domestic consumption	Exports to other major areas	Total demand
United States*	5,085.2	363.5	5,448.7	437.3†	5,886.0	—13.8	5,449.2	450.6†	5,899.8
North America	5,260.9	365.9	5,626.8	553.5	6,180.3	—13.8	5,965.2	228.9	6,194.1
South America	1,417.4	8.9	1,426.3	19.7	1,446.0	—	430.3	1,015.7	1,446.0
Western Europe	33.2	6.0	39.2	768.1	807.3	—20.3	820.6	7.0	827.6
Eastern Europe	95.0	16.2	111.2	24.3	135.5	—	99.0	36.5	135.5
Africa	25.5	0	25.5	142.9	168.4	—	168.4	0	168.4
Middle East	840.3	0	840.3	2.0	842.3	—	160.0	682.3	842.3
East Asia	11.2	0	11.2	198.4	209.6	—	209.1	0.5	209.6
Oceania	56.1	0	56.1	93.9	150.0	—	146.0	4.0	150.0
U.S.S.R. (incl Sakhalin)	543.0	1	544.0	42.6	586.6	—	581.1	5.5	586.6
Undistributed (Military)				135.0	135.0		135.0		135.0
World total	8,282.6	398.0	8,680.6	1,980.4	..	—34.1	8,714.7	1,980.4	..

*Shown for comparison. †Including exports to and imports from other North American countries.
‡Not available for countries other than United States and United Kingdom.

BREAKDOWN OF ABOVE DEMAND BY COUNTRIES

(Barrels Daily)

	1947
Continental U. S.	5,449,200
Canada	262,700
Mexico	132,300
Alaska	6,000
Hawaii	21,000
Puerto Rico	12,000
Virgin Island, Guam—American Samoa, Canton and Endeberry Island	1,000
Total Non-Contig	40,000
Bahamas	350
Bermuda	800
British Honduras	200
Costa Rica	2,200
Cuba	32,050
Dominion Republic	1,700
El Salvador	1,400
Guatemala	3,300
Haiti	700
Honduras	2,700
Jamaica	2,700
Newfoundland	4,000
Nicaragua	900
Panama	3,000
Panama Canal Zone	25,000
Total other North America	81,000
Total North America	5,965,200

	1947
Argentina	135,900
Bolivia	2,000
Brazil	50,000
Chile	25,000
Colombia	18,100
Ecuador	4,300
N. W. I.	105,800
Venezuela	30,000
Paraguay	400
Peru	23,700
Trinidad and Tobago	21,700
Uruguay	10,000
Barbados	500
British Guiana	900
Martinique	300
Falkland Islands	200
Antarctica	1,500
Total South America	430,300
N.W.I. to U.S./Brit. military	45,000
Total	471,500

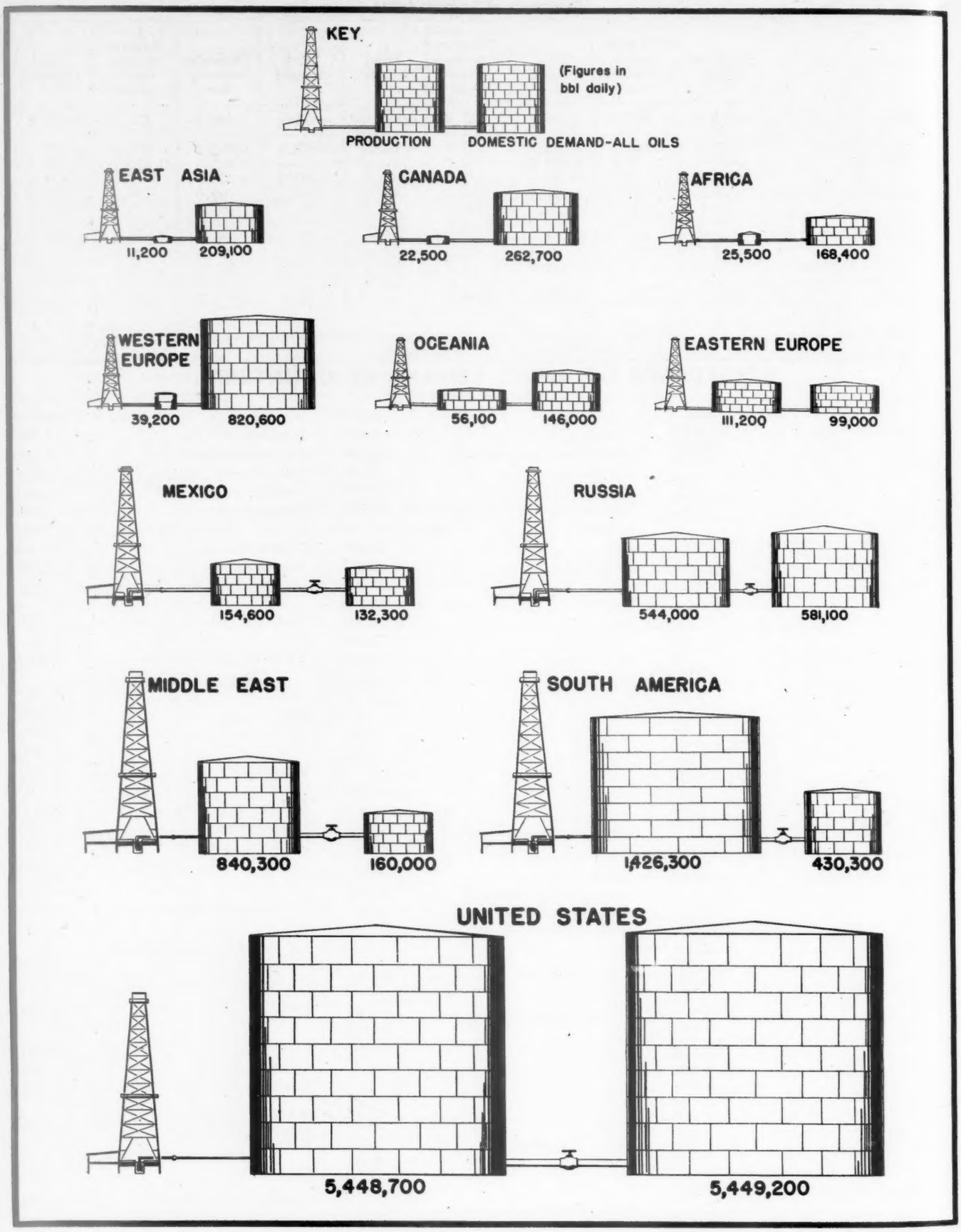
	1947
Austria	8,000
Belgium and Luxembourg	32,000
Denmark	25,000
France	135,000
Germany (excl U.S.S.R. Zone)	30,000
Ireland	11,000
Italy	70,000
Netherlands	50,900
Norway	20,000
Portugal	13,000
Spain	22,000
Sweden	55,000
Switzerland	18,000
Iceland	2,100
U. K.	301,400
Malta	2,000
Gibraltar	4,000
Undis. and Military	21,200
Total Western Europe	820,600
Egypt	50,000
Union of South Africa	33,000
Other South and East Africa	25,400
North and West Africa	60,000
Total Africa	168,400
China (incl Hong Kong)	90,000
India	59,100
Ceylon	13,000
Japan	25,000
Afganistan	—
British Malaya	13,000
Burma	5,000
French Indo China	2,000
Siam	2,000
Total East Asia	209,100
Total U.S.S.R.	581,100

	1947
Bulgaria	2,000
Czechoslovakia	7,000
Finland	5,000
Greece	14,000
Hungary	5,000
Poland	7,000
Rumania	38,500
Yugoslavia	5,000
Albania	500
East (U.S.S.R.) Germany	15,000
Total Eastern Europe	99,000
Aden	17,000
Cyprus	13,000
Iran	51,000
Iraq	10,000
Kuwait	1,000
Palestine	30,000
Arabia and Bahrein	35,000
Trans-Jordan	4,000
Syria and Lebanon	4,000
Turkey	6,700
Total Middle East	160,000
Est. Persian Gulf to U.S./Brit. Military	90,000
Total	250,000
Australia	60,000
New Zealand	16,000
Philippines	20,000
British North Borneo, Sarawak and Borneo, N. E. I.	40,000
Fiji Islands	500
Undistributed	9,500
Total Oceania	146,000

Source: Estimates representing most reliable and authentic information available from private and official sources.
Note: Some figures are of necessity approximations only.

From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.

PETROLEUM PRODUCTION RELATED TO DEMAND



United States, South America, and Middle East provide 88.5 per cent of world's oil requirements.

From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.

YOU CAN BE **SURE**.. IF IT'S

Westinghouse

YOU CAN "DRAG" IT and weld with Hotter stubs

It's the new FP-2 electrode

Over 50 impartial tests have proved that the new FP-2 (6012) electrode . . . *gives better welds with hotter stubs . . . is better for "skip" and "drag" welding . . . gives a flatter bead . . . and has less undercut* than any electrode you have ever used. That's why it's a . . .

High-speed production tool . . . one you can burn with higher amps—until the stub is red-hot—and get good sound welds free of slag pits and gas pockets. And you can . . .

"Drag" it or "skip" it because the wire melts away faster than the heavy coating to form an inverted flux cup that's full of molten metal. What's more, the FP-2 is an . . .

All-position a-c—d-c electrode for easier, faster, better welding with all types of welding machines. Use it once and you'll be convinced.

For full details on the new FP-2, send for Page 29.1 (Catalog 26020). Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

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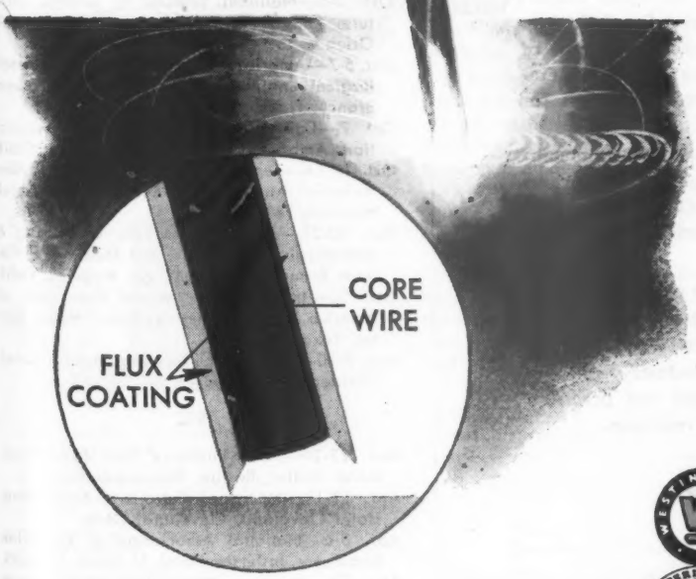

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QUALITY in world famous W-S Forged Steel Fittings starts with proper selection of basic metals. Long before problems of forging, machining and testing arise, W-S technicians concern themselves with end uses in the determination of proper steel analysis for the various jobs Fittings must perform.

For example, working closely with Refinery engineers, W-S technicians helped establish standards for the physical properties of various fittings alloys . . . were first to use fitting materials of closely controlled uniformity (low sulphur-low phosphor) for the special demands of refinery services.

And, W-S has kept pace with changing methods in other processing industries too, meeting each new challenge with stronger, tougher alloys, producing forged fittings always correct — metallurgically.

They meet the broad, diversified needs of all industry and are available in both screw and socket weld types. Forged and precision machined of stainless, carbon and alloy steel . . . . Investigate.

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ROSELLE, NEW JERSEY

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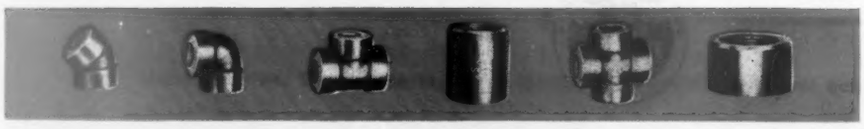

SOLD THROUGH LEADING DISTRIBUTORS

MEETINGS

June 16-17—Pennsylvania Grade Crude Oil Assn, Annual Meeting, William Penn Hotel, Pittsburgh, Pa.

June 16-20—Canadian Gas Assn, Annual Convention, Bigwin Inn, Lake of Bays, Ont., Canada.

June 23-24—Kentucky Oil & Gas Association, Annual Meeting, Lexington, Ky.

June 27-July 1—American Society for Testing Materials, Annual Meeting, Hotel Chalfonte, Haddon Hall, Atlantic City, N. J.

July 11—Nomads, Ye Ole College Inn, Houston, Texas.

July 13—Nomads, Jonathan Club, Los Angeles, Calif.

Aug. 17-Sept. 6—United Nations Scientific Conference on the Conservation and Utilization of Resources, U. N. Interim Headquarters, Lake Success, N. Y.

Aug. 17-19—SAE, West Coast Meeting, Multnomah Hotel, Portland, Oregon.

Sept. 12-16—Instrument Society of America, Annual Meeting and Exhibit, Municipal Auditorium, St. Louis, Mo.

Sept. 14-16—National Petroleum Association, Hotel Traymore, Atlantic City, N. J.

Sept. 14-15—API, Lubrication and Marketing Division, Hotel Traymore, Atlantic City, N. J.

Sept. 17-20—AGA, Annual Convention, Chicago, Ill.

Sept. 18-20—American Institute of Chemical Engineers, Mt. Royal Hotel, Montreal, Canada.

Sept. 19-21—American Association of Oilwell Drilling Contractors, Annual Meeting, Baker Hotel, Dallas, Texas.

Sept. 24-27—American Institute of Mining & Metallurgical Engineers, Regional Meeting, Neil House, Columbus, Ohio.

Oct. 2-5—American Society of Mechanical Engineers, Petroleum Division, Petroleum Mechanical Engineering Conference, Biltmore Hotel, Oklahoma City, Okla.

Oct. 3-4—National Assn of Corrosion Engineers, Annual Meeting, Adolphus Hotel, Dallas, Texas.

Oct. 3-5—National Lubricating Grease Institute, Annual Meeting, Roosevelt Hotel, New Orleans, La.

Oct. 5-7—American Institute of Mining & Metallurgical Engineers, Fall Meeting, Petroleum Branch, Plaza Hotel, San Antonio, Texas.

Oct. 7—California Natural Gasoline Association, Ambassador Hotel, Los Angeles, Calif.

Oct. 13-14—Texas Mid-Continent Oil and Gas Association, Annual Meeting, Rice Hotel, Houston, Texas.

Oct. 20-21—American Institute of Mining & Metallurgical Engineers, Fall Meeting, Petroleum Branch, Elk's Club, Los Angeles, Calif.

Oct. 31—Independent Natural Gas Assn of America, Annual Meeting, Baker Hotel, Dallas, Texas.

Nov. 7-10—API, Annual Meeting, Stevens Hotel, Chicago, Ill.

1950

Mar. 23-24—New England Gas Association, Hotel Statler, Boston, Massachusetts.

Apr. 12-14—National Petroleum Association, Hotel Cleveland, Cleveland, Ohio.

Apr. 3-6—National Association of Corrosion Engineers, Jefferson Hotel, St. Louis, Missouri.

Apr. 23—American Association of Petroleum Geologists, Chicago, Illinois.

June 19-24—Canadian Gas Association, Annual Meeting, Manoir Richelieu, Murray Bay, Que., Canada.

Sept. 13-15—National Petroleum Association, Hotel Traymore, Atlantic City, New Jersey.

Nov. 13-16—API, Annual Meeting, Los Angeles, California.

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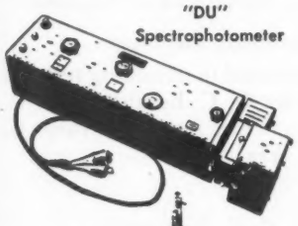
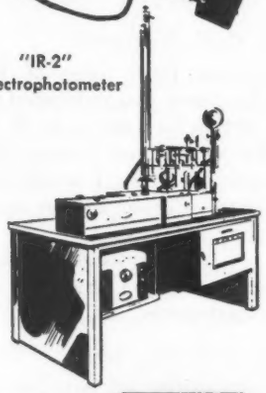


"IR-2"
Spectrophotometer



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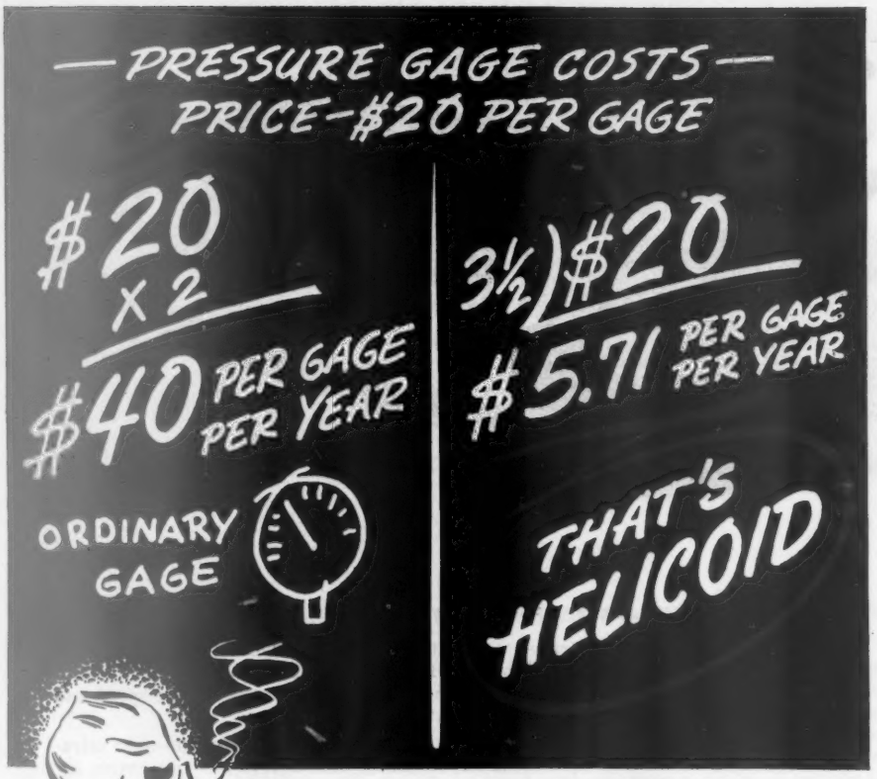

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Thus, the money made by using Helicoid would be from $34.29 to $54.29 per gage per year. Send for your copy of the new Helicoid Gage catalog now.

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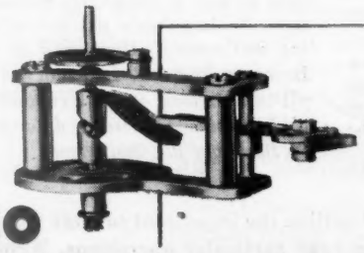

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LETTERS
to the Editors

Interest in Reprints

To The Petroleum Engineer:

Your recent articles, "Hydrocarbon Absorption and Fractionation Process Design Methods" by W. C. Edmister, have been very good and if it is possible I wish to obtain several reprint copies of the complete series.

Eugene J. Obert,
Stanolind Oil and Gas Company,
Tulsa, Oklahoma.

To The Petroleum Engineer:

Will you advise me as to whether the series of articles by W. C. Edmister will be published later in book form or whether it is possible to obtain reprints of the articles?

R. T. W. Hall,
University of Birmingham,
Edgbaston, Birmingham, England.

To The Petroleum Engineer:

I am interested in obtaining reprints of articles by W. C. Edmister.

Ing. Leopoldo Nunez G.
Minatitlan, Ver.,
Mexico.

To The Petroleum Engineer:

In the March 1949 issue of The Petroleum Engineer you published the concluding article in a series by W. C. Edmister. Do you intend to issue this series as reprints? If so, I would like to have a copy. Please let me know how much they will cost.

George A. Randall,
E. B. Badger and Sons Company,
Boston, Massachusetts.

To The Petroleum Engineer:

The recent series of articles by W. C. Edmister that appeared in the Petroleum Engineer was exceedingly interesting and will be followed up by a large call for reprints. With this in mind, I would like to know the price per reprint as well as the club price if one has been established. This series with its comparisons of the current design methods is invaluable to the design man.

Ralph G. Ruth,
Process Engineer,
Tulsa, Oklahoma.

Editor's Note: *We have had scores of requests for the Edmister series such as those above. At first we hesitated to reprint the articles because the 132 pages made it a large project, but because of the high demand it was decided to issue reprints for printing costs only. The entire series of 20 articles is now available at $2.50 a copy.*

THE Petroleum Engineer

JUNE
1949

Could Alberta Gas Be Exported?

H. G. COCHRANE

HALF a century ago Rudyard Kipling, visiting Canada's western Provinces, dramatized the convenience of natural gas as a fuel, by aptly referring to Medicine Hat, Alberta, as "the town that was born lucky, with 'all hell' for a basement." Since then there has been a several hundred-fold increase in the number of Alberta natural gas consumers. Projects are mooted for piping gas to serve other large centers in western Canada and northwestern Pacific states. What picturesque remark would be forthcoming, were the well known author alive today and able to revisit Alberta?

For today the production and use of natural gas in Alberta is big business. Gross income to producers from sales of this fuel is probably about a fifth of the income from domestic crude oil production. While other provinces are almost entirely dependent on domestic or imported coal, on imported petroleum, or on hydro power for their energy requirements. Alberta though itself a coal producing province, gets one-ninth of its energy from natural gas and nearly a third from gas or oil. Gas provides cheaper heating than electricity or oil, and according to evidence at recent hearings before the Natural Gas Commission, coal cannot compete with gas on a cost basis. Indeed, unless coal prices are sharply reduced there is a very strong incentive to increased use of gas as a fuel.

Is Alberta destined to become the Canadian "Texas," supplying the rest of the Dominion by pipeline, as Texas supplies the U. S., with natural gas fuel? Today customers all over the United States are consuming close to 6 trillion cu ft of natural gas yearly, or at a rate equal to a thirtieth of known reserves. To transport this tremendous volume, the equivalent of about 250 million tons of coal, there have been built hundreds of thousands of miles of pipe lines, reaching from fields in Texas and Oklahoma to El Paso, Atlanta, Georgia, Denver, Colorado, St. Louis, Missouri, Chicago, Illinois, and various cities in New York state, some of them upwards of a thousand miles in length. Can Alberta supply Canadian cities in the same way? Or will Alberta allow the gas to be exported for U. S. cities?

History of Gas in Alberta

Natural gas was first piped to Calgary from the Bow Island field near Medicine Hat in 1913. Its use grew rapidly. At this time the price was 33 cents per 1000 cu ft, and 87 per cent of all commercial customers served used gas for heating purposes.

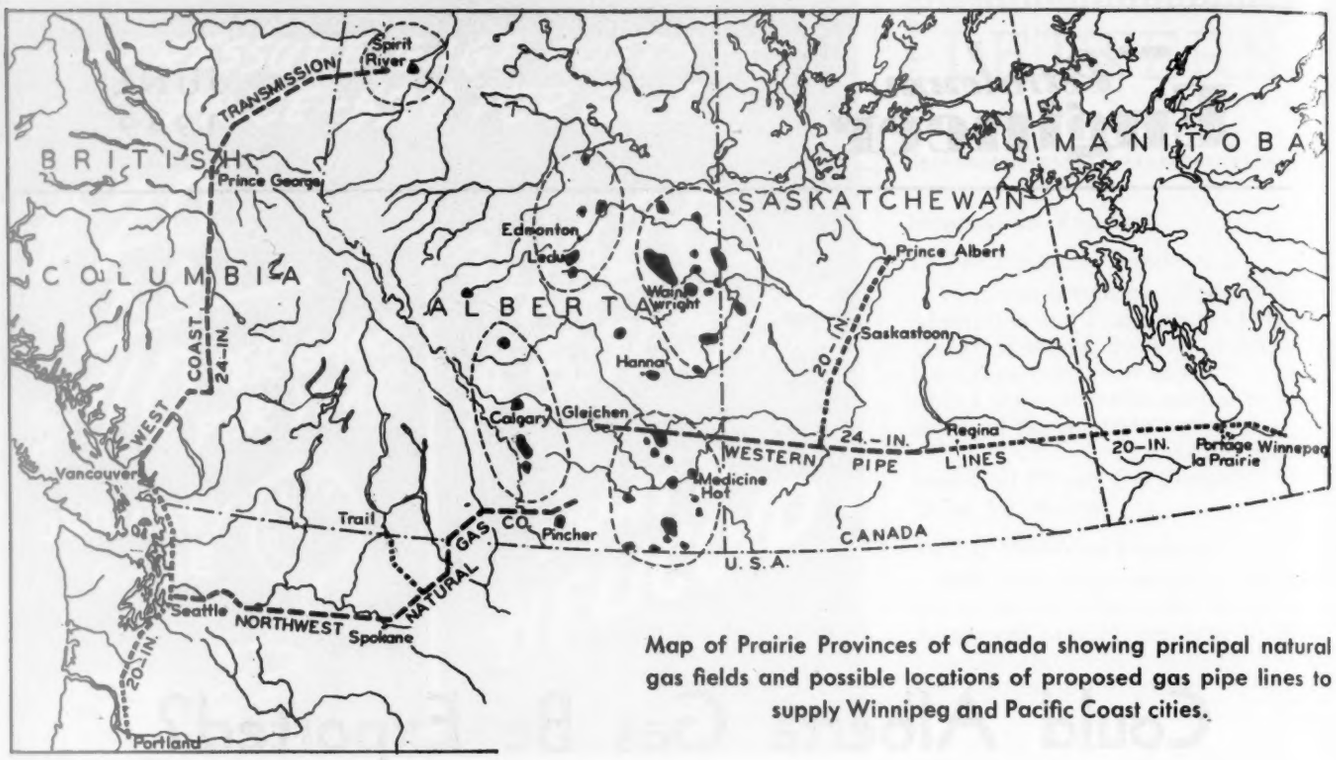
EXCLUSIVE

In 1918, the supply became depleted, however, and not until it was again augmented from Turner Valley about 1924 did its use recover. Meantime gas was supplied to Edmonton in 1924 from the Viking field and from the Wainwright field in 1927.

Of the total of close to 2 million cu ft of gas withdrawn to date from Alberta fields, about a quarter has been marketed, a quarter used for operations in the field, including that needed to force oil to the surface, and the remaining half has been wasted. Gas flares in Turner Valley in the late twenties and early thirties nightly cast their rosy glow over the landscape, until the Alberta Conservation Board put a stop to the practice. Since that time waste has sharply declined. Over this period marketings have steadily increased, though domestic use has declined relatively in importance while the proportion of industrial use has grown steadily.

Reserves—Known and Expected

Existing and proven reserves of natural gas in the prairie provinces today, according to Dr. G. S. Hume, Chief of the Geological Survey of Canada, amount to 4¼ trillion cu ft, calculated to an abandonment pressure of 100 lb psi at 60 degrees. Below this, the pressure is considered insufficient for withdrawal. Half of



Map of Prairie Provinces of Canada showing principal natural gas fields and possible locations of proposed gas pipe lines to supply Winnipeg and Pacific Coast cities.

these reserves are divided about equally between the foothills area south from Calgary to the U. S. border, and the fields astride the Alberta-Saskatchewan boundary between Wainwright and the Battlefords. The balance is divided about equally between three fields centering around Medicine Hat and Bow Island, Brooks and Princess, and Leduc and Redwater. A further major supply, not included by Hume, is apparently being uncovered in the Pincher Creek area. Other geological experts concur in Hume's estimate. Their forecasts as to possible further reserves that will be discovered over the next five years range from an additional 3 trillion to 10 trillion cu ft and upwards. Thus by 1954 there may be reserves of anywhere from 7 to 17 trillion cu ft, or enough to supply annual consumption of present distribution systems (as estimated at 70 billion ft yearly by 1960), for between 100 and 200 years, or even longer.

Applications to Export

Spurred by population growth and by the sharp increases in oil and coal prices, many applications have lately been placed before the Alberta Government for permission to export this gas to other areas. First came "Western Pipelines," sponsored by a Winnipeg group, who wanted to build a 710 mile, 24-in. pipeline, costing $50 millions for the line and $25 millions more for the distribution system, from a gathering point at Gleichen, Alberta, to supply Saskatoon, Prince Albert and Winnipeg with about half as much gas as is now withdrawn yearly from Alberta fields, at prices per thousand cu ft of 64 cents for domestic and 48 cents for commercial consumers.

The Northwest Natural Gas Company, sponsored by American interests, seeks permission to export an amount of gas roughly equal to present total Alberta withdrawals (two-thirds of which are marketed), by means of 1000 miles of gathering lines and a 24-in. pipeline 574 miles long, from MacLeod, Alberta, via the Crows Nest, to supply Spokane, Trail, British Columbia, Seattle, Portland, and Vancouver. The capital cost is estimated at $100 millions, 40 per cent of which would be spent in Canada. Gas would be marketed at from $.30 to $.40 per thousand cu ft. Income for Alberta would be $7 millions yearly.

Yet another scheme, known as the West Coast Transmission Company, or the Frank McMahon project, proposes to supply Vancouver and U. S. Pacific coast cities by a pipe from Peace River via Prince George, at an estimated capital cost of from $50 to $100 millions, depending on location. This project is sponsored by Pacific Pete, Tidewater, Sunray, and Eastman-Dillon interest. Canadian Western Natural Gas Company and Northwestern Utilities, the two largest Alberta operating companies, are interested in building an integrated gathering grid system in Alberta, to tie together all producing Alberta gas fields, though not necessarily for the purpose of export.

All of these applications have posed a serious question for the Government of Alberta. Would the people of the province approve of this export, relying on the incentive it would give to further exploration, thus adding greatly to known reserves of gas, and benefiting as they would by a greatly increased volume from the provinces' resources? Or alternatively would Albertans take the view that this cheap source of fuel should be conserved for their own present and future use? To find the answer the Province appointed last November a three man Natural Gas Commission to study the question thoroughly and make a complete report. This report has just recently been tabled in the Alberta legislature.

Findings of the Commission

The Commission accepted the experts' appraisal of 4¼ trillion cu ft of existing and proven reserves. They point out that of this quantity only 3½ trillion cu ft are marketable. They accepted the judgment of witnesses that potential reserves will ultimately prove "to exceed many times" the present and proven reserves. These further additions are dependent only on exploration and development. Of

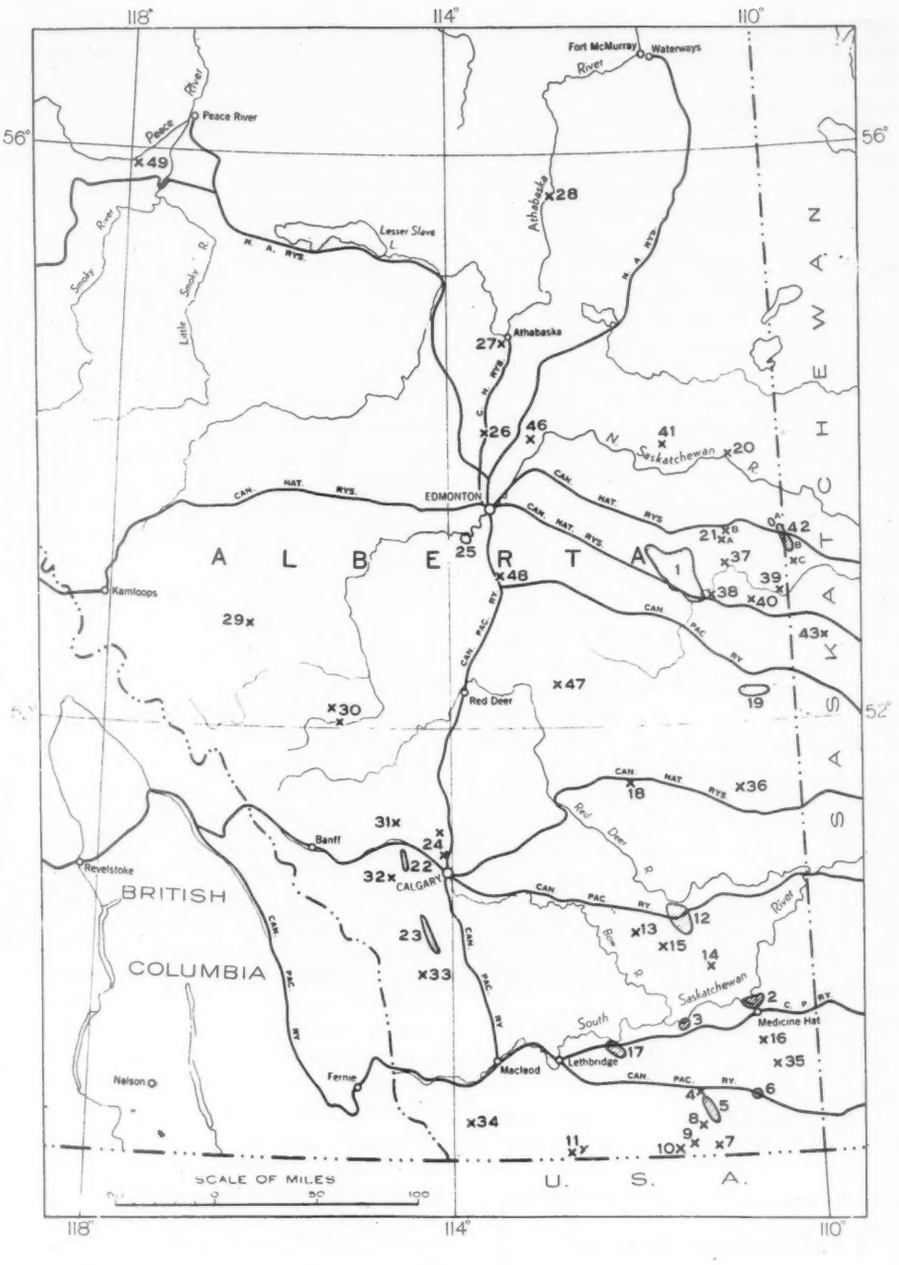
the 58 billion ft of present annual withdrawals, two-thirds is marketed, the balance goes for field use, shrinkage and waste. By 1960 marketed gas will increase to 70 billion ft per year.

Gas is rapidly replacing coal as a fuel in Alberta. If its sale were confined to local markets, the Commission believes that the gas resources of the Province would continue to provide a relatively cheap fuel. There are sound reasons to expect an increase in the use of gas in industry as fuel and as a raw material.

The present ratio of reserves to withdrawals is 70 to 1. This is a high ratio, but the trend is important. If the trend is upward or constant, the reserve situation is healthy. A downward trend would call for a reappraisal. Without export, the ratio should tend to increase. However, experts consider a ratio of 50 to 1 is adequate. This would not assure a supply for 50 years, but as long as additions exceed withdrawals the prospects of the supply lasting are enhanced. Examples worked out by the Commission appear to show that to supply Saskatchewan and Manitoba, and the several coast cities in British Columbia, Washington, and Oregon as well, and yet maintain the 50 to 1 ratio, probable discoveries of further reserves would have to amount to over 12 trillion cu ft over the 50-year period. The Commission considers that neither prospective discoveries or increased utilization is measurable, and the use of judgment is unavoidable in dealing with the problem.

The Commission expressed itself as fully in accord with the principle of local priority in the matter of supply. Pointing to current U. S. policy of assuring priority to users of gas within that country, they further supported the principle of priority to Canadian users. They were not convinced that sales outside the province need cause an increase in price within the province, but felt they were not in a position to suggest how Alberta users could be protected as to price. They pointed out that revenues to prospective importers would enable them to contribute very substantially to Government revenues.

Realizing that disposal of gas will continue a major problem for some time, the Commission called attention to the merits of the proposed grid system tying in the various gas fields as a means of eliminating waste. They pointed out, however, that the Alberta Gas Companies could not afford to undertake this development unless movement of gas outside the province was contemplated. The best conditions



Key map to gas fields and areas discussed in gas appraisal report.

1. Viking-Kinsella-Fabyan
2. Medicine Hat-Redcliff
3. Bow Island
4. Foremost
5. Pendant d'Oreille
6. Manyberries
7. Black Butte and Pinhorn
8. Smith Coulee
9. Dead Horse Coulee
10. Erickson Coulee
11. Del Bonita-Twin River
12. Princess
13. Brooks
14. Suffield
15. Tilley
16. Dunmore
17. Barwell or Chin Coulee
18. Hanna
19. Provost
20. Elk Point
21. Vermilion(A), Borradaile(B)
22. Jumpingpound
23. Turner Valley
24. Nose Creek
25. Leduc
26. Legal
27. Athabaska
28. Pelican
29. Brazeau
30. Ram River-Clearwater
31. Keystone Valley
32. Moose Mountain
33. Pekisko
34. Pincher Creek
35. Eagle Butte
36. Oyen
37. Battleview
38. Wainwright
39. Dina
40. Edgerton
41. St. Paul
42. Lloydminster (A, Alberta. B, Sask. C, Lone Rock, Sask.)
43. Unity, Sask.
46. Redwater
47. Stettler
48. Nisku-Wetaskiwin
48. Pouce Coupé

under which "export" might be permitted would be obtained from pooling the province's gas reserves, by means of such a grid system.

Concluding their report, the Commission pointed out that "resources merely occupy space unless they are put to use to serve human needs.... Albertans must ensure they are widely used, with due regard to all legitimate claims upon them, and with regard to the relation between different resources, particularly as between coal and natural gas.... Evidence that use of oil and gas in industry and in homes is likely to cause considerable displacement of coal, is a matter of grave concern."

In keeping with the terms of reference, no recommendation was made respecting the question of export of natural gas.

During the hearings, considerable evidence was given by engineers and economists as to the prospects for an expanding industrial market within the province for natural gas. H. Zinder, of Washington, D. C., a utility consultant to the Federal Power Commission, stated that a study in 1939 by the Natural Resources Planning Board had shown that the availability of cheap and abundant natural gas was not generally effective in motivating the migration of industries in the United States. The most important economic factors determining location of industry were (1) market considerations, (2) labor, cost differentials and, (3) raw materials, including fuel; in that order.

J. R. Donald, of Donald Chemical Company, Montreal, on the other hand, pointed to the growing importance of natural gas in industry, particularly for blast furnace products, cement, clay products, hardwood distillation, and lime. Its use as a fuel in petroleum refining is a recent significant development. Chemical industries based on limestone and salt, and sulphur from sour gas are further potential users of natural gas. Carbon black production is another possibility. All such industries use resources that are plentiful in Alberta. On a proportionate basis to what has taken place in the southwestern states during the war and since, Alberta could reasonably expect capital investment of $150 millions or thereabouts by the petro-chemical industry in areas where cheap and abundant natural gas is available.

Pipelines Can't Depend on Domestic Load

Uniformity of volume of flow (high load factor) through any pipeline is essential to cheap transportation costs. A 24-in. pipe, 500 miles long, for example, running full all the time could transport gas for less than 7 cents per thousand cu ft. Under 40 to 50 per cent load factors, conditions such as presently obtained for pipelines in Alberta, where load is about half domestic and half commercial and industrial, and where domestic load disappears in the summer months, transportation would cost almost three times as much. Thus for low cost gas in temperate or cold climates, it is essential to have as large a proportion of industrial use as possible, which is continuous throughout the year. It may also be necessary to accept industrial contracts on an interruptable basis when domestic demand in cold weather loads lines to capacity. A possible alternative is storage in the summer months in abandoned fields near industrial centers of demand, but this would not be possible near coast cities or close to Winnipeg where no abandoned gas fields exist.

Pipeline Legislation

At the current session of Parliament, legislation has been introduced providing for Federal control of interprovincial and international oil and gas pipelines. Control will be exercised through the Board of Transport Commissioners, as is already done in the case of railways, telegraphs, telephones, express service, international bridges and tunnels, and certain classes of ships. Oil pipelines, though not those for gas, will be designated as common carriers; gas pipeline operators may be ordered to extend or improve transportation facilities if no undue burden on the owners is apparent therefrom.

It appears doubtful that the Alberta Government will come to any hasty decision with respect to export of gas. The question might even be put to the people of the province in the form of a referendum. From opinions expressed before and by the Commission, there is good reason to assume that the neighboring prairie provinces of Saskatchewan and Manitoba will get preference if any export is permitted. Reading between the lines, it may be inferred that the Commission would have recommended this 'export' at least, had their terms of reference called for a recommendation. This would justify the grid system which has the Commission's blessing, and would doubtless pave the way for further gas exploration resulting in sharply increased reserves. This increase in turn would probably justify pipe lines to serve cities on the coast.

Promoters in the past have had dreams of supplying Ontario centers such as Toronto with Alberta natural gas. While in principle, the Commission would doubtless favor this rather than the export to U. S. Pacific coast cities, it has not been shown that there are sufficient reserves as yet for such a project. Moreover, the transportation cost alone from Alberta to Toronto would bring its delivered price there very close to the cost of production for manufactured gas in the Toronto area. Winnipeg is different, it is only half the distance to Toronto and its coal is more expensive.

Vancouver would have just as much right to Alberta gas as would Winnipeg. The British Columbia Power Corporation would gladly take it to replace the supply to their customers of manufactured gas. But spokesmen for this company and for the promoters of the West Coast Transmission Company concede that a pipeline to serve Vancouver alone would not be economically feasible. Hence Vancouver's chances depend on greater reserves and on a decision to export across the border.

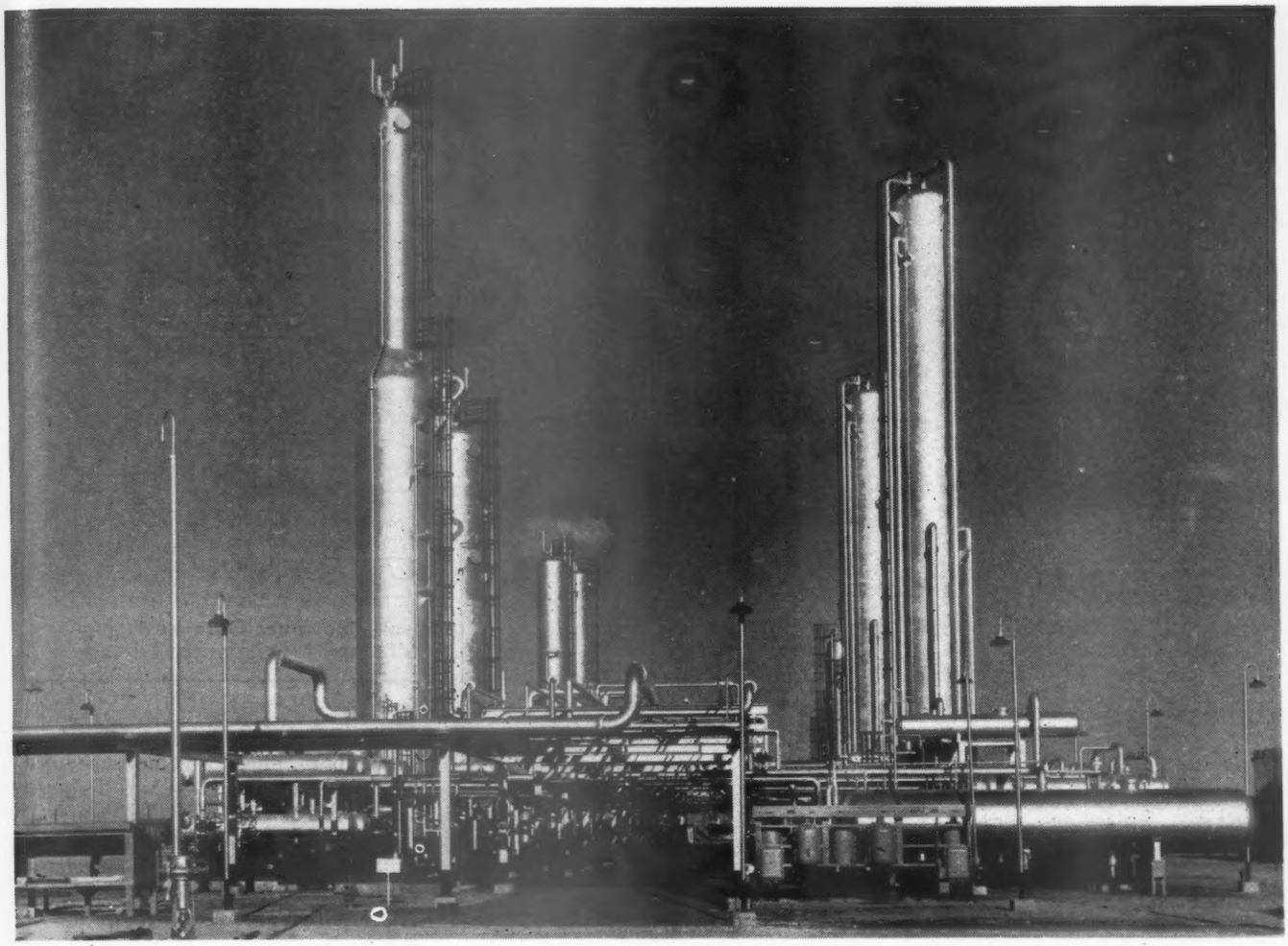
One of the most important observations contained in the Commission's report related to future gas from Alberta coal. Long before Alberta's gas reserves were used up, they stated, a high BTU manufactured gas from domestic coal would be available in abundant quantities at reduced cost. If this be true it would seem the people of Alberta, if they want to make hay while the sun shines, could not afford not to approve the export of their natural gas, always of course giving preference to Albertans and then to consumers in other Canadian provinces.

* * *

3 Fellowships Granted

Three oil companies have announced establishment of fellowship awards in petroleum engineering. Stanolind Oil and Gas Company, Humble Oil and Gas Company, and Shell Union Oil Corporation and its associated companies have established fellowships to be open for appointment September 1, 1949. Stipend of fellowships is $1250 per academic year, with the exception of Shell, which grants an additional sum of $300 per year for purchase of research equipment.

Applications for fellowships are being received by Dr. John C. Calhoun, Department of Petroleum Engineering, University of Oklahoma, Norman, Oklahoma.



General view of process area of Slaughter gasoline plant, looking east. Plant is 4½ miles west of Sundown, Texas. Plant processes casinghead gas to extract butane, propane and natural gasoline. Capacity—90,000,000 cu ft of gas per day.

Slaughter Gasoline Plant

J. S. BELLAH*, R. V. MERTZ*, and J. W. KILMER*

ONE of the world's largest high pressure casinghead gasoline plants recently went into operation in the Slaughter Field of West Texas. This plant is an outstanding example of cooperation by a group of companies to secure economically the maximum utilization of natural resources.

Eight companies are joint owners in this venture. They are Stanolind Oil and Gas Company, The Texas Company, Honolulu Oil Corporation, Magnolia Petroleum Company, Devonian Oil Company, Atlantic Refining Company, Saltmount Oil Company, and Mid-Continent Petroleum Corporation. Although Stanolind is the largest owner in the plant, and is the Operator, its participation is only a little more than 25 per cent.

The Slaughter Field lies in Cochran, Hockley and Terry Counties in West Texas. The discovery well was drilled in 1936 and opened up what turned out to be the third largest oil field, in acreage, in the United States. The field as presently developed contains some 75,000 acres, is about 15 miles long and 10 miles wide, with the longer axis lying generally in an east-west direction. There are now about 2000 wells producing from the San Andres limestone at an average depth of 4900 ft. The 1948 crude production was about 19,700,000 bbl. Slaughter crude is black, sour, and has an API gravity of 34 deg.

Capacity of Plant

More than 97 per cent of the oil producing wells in the field are connected to the gasoline plant gathering system. The Slaughter gasoline plant

*Stanolind Oil and Gas Company, Tulsa, Oklahoma.

is located in Hockley County about 12 miles southwest of Levelland. The plant is designed to ultimately process 120,000,000 cu ft per day, although equipment is installed initially to process 90,000,000 cu ft per day. The increased capacity can be attained in the future by the addition of a relatively small amount of equipment.

Design recovery of liquid products, when processing 90,000,000 cu ft per day of gas having the composition shown in Table 1, is about 50,000 gal per day of propane, 92,000 gal per day of butanes, and 100,000 gal per day of debutanized gasoline.

Design Gas Composition

Component	Mol Per Cent
Hydrogen sulfide	1.0*
Carbon dioxide	5.9†
Nitrogen	19.4
Methane	59.3
Ethane	10.5
Propane	6.4
Butanes	3.7
Pentanes	1.7
Hexanes and heavier	1.1
	100.0

*Hydrogen sulfide may range up to 1.5 per cent.
†Carbon dioxide may range up to 7.5 per cent.

All residue gas except that used for plant and lease fuel is being sold to the El Paso Natural Gas Company.

Operating Features

The plant incorporates a number of interesting process and mechanical features, including (1) a "split flow" Girbotol unit to sweeten the field gas, (2) a fractionating reabsorber designed to deethanize the rich oil, making it practical to operate with only one stripping still and eliminating the necessity for a separate deethanizer, and (3) an indirect heating system, employing oil as a heat medium, that supplies about 90 per cent of the process heating load, thus reducing the size of the steam plant.

The plant is designed to recover 32 per cent of the propane, 85 per cent of the butanes, and 99 per cent of the pentanes and heavier content of the wet field gas. Design recovery was set at the maximum possible consistent with heating value specifications of the residue gas.

Plant construction was begun in December, 1947, and plant operation started on February 15, 1949, about one month ahead of the scheduled start-up time. The plant was designed and constructed by C. F. Braun and Company in cooperation with a committee of engineers representing the various plant owners.

Simplified process flow diagrams of the various sections of the plant are shown in Figs. 1, 2, and 3.

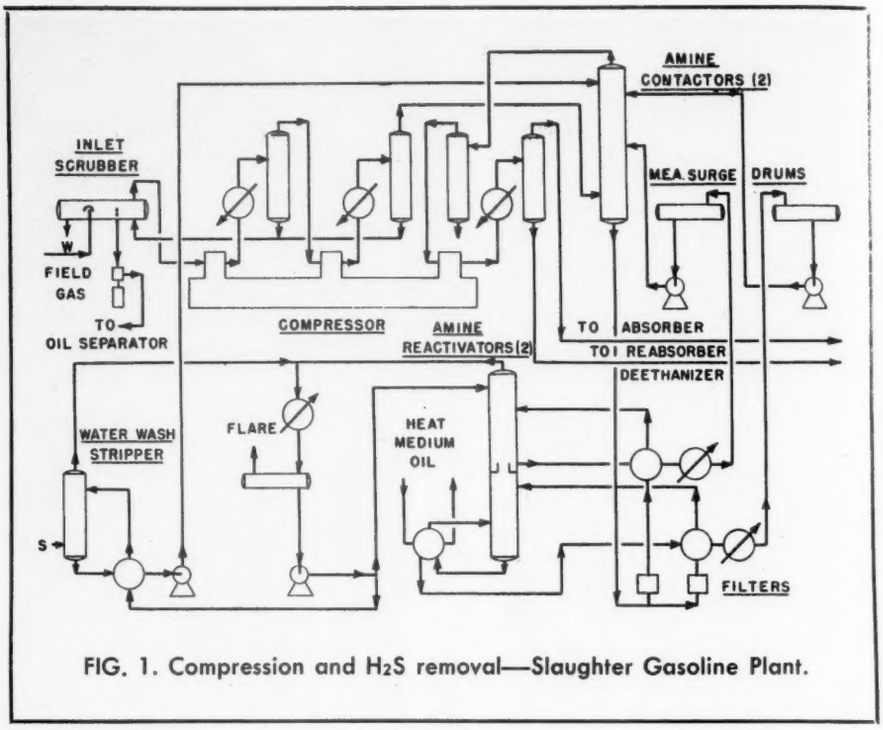


FIG. 1. Compression and H_2S removal—Slaughter Gasoline Plant.

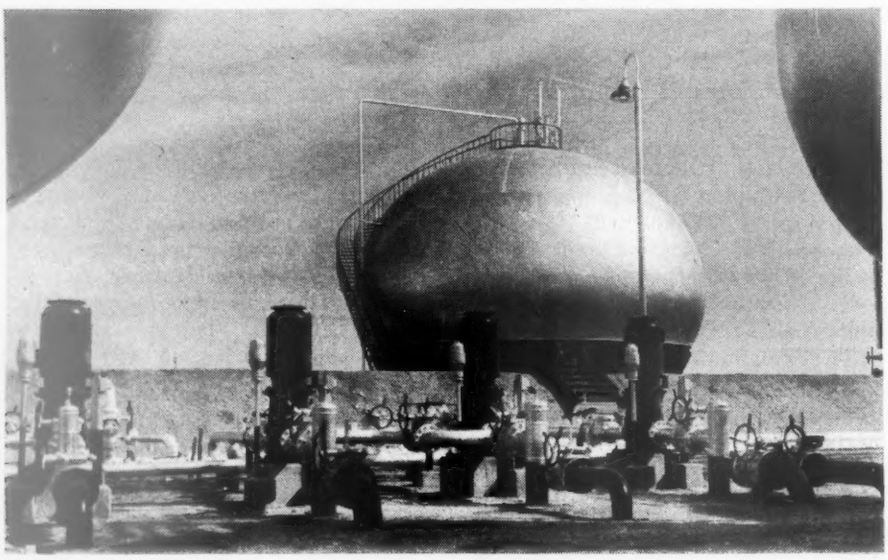
Field System

The field gas gathering system is designed to collect gas from field separators operating at about 10 psig, delivering it to the gasoline plant at a pressure slightly above atmospheric. The entire gathering system is designed to operate above atmospheric pressure in order to eliminate the possibility of air infiltration which would be undesirable because of the hydrogen sulphide content of the gas. The system consists of 7 main lines with branch lines connecting to the well batteries. This gas gathering system, one of the largest of its kind, contains about 200 miles of pipe ranging from 2 in. to 30 in. in diam. The field system also includes a residue gas system to return dry sweet gas to all leases.

Field Gas Compressors

The plant field gas compressors (Fig. 1) consist of sixteen 1600 hp (sea level rating) 2 cycle, right angle, gas engine driven units designed to compress about 90,000,000 cu ft per day from 13.2 psia to 713 psia. Each machine is equipped with three stages of compression designed with sufficient flexibility to compress 10 per

Product storage area of the gasoline plant. Spherical tank is one of two that each hold 7500 bbl of natural gasoline.



cent additional gas by an increase in suction pressure to 18.2 psia. These compressors are derated to about 1500 bhp each at the 3000-ft altitude of the plant location.

Field gas enters the plant through a 12 ft by 40 ft horizontal scrubber designed to remove entrained crude oil, scale, and other foreign material. Gas from this scrubber flows to the compressor first stage suction header at essentially atmospheric pressure, and is compressed through two stages to about 180 psig.

The second stage discharge gas is cooled, passed through a separator and flows to the hydrogen sulphide removal system where H_2S and CO_2 are removed by contacting with a water solution of monoethanolamine. Sweet gas from the amine contactors passes through residue scrubbers, enters the third stage of compression at about 165 psig, and is compressed to 700 psig, the operating pressure of the main absorber.

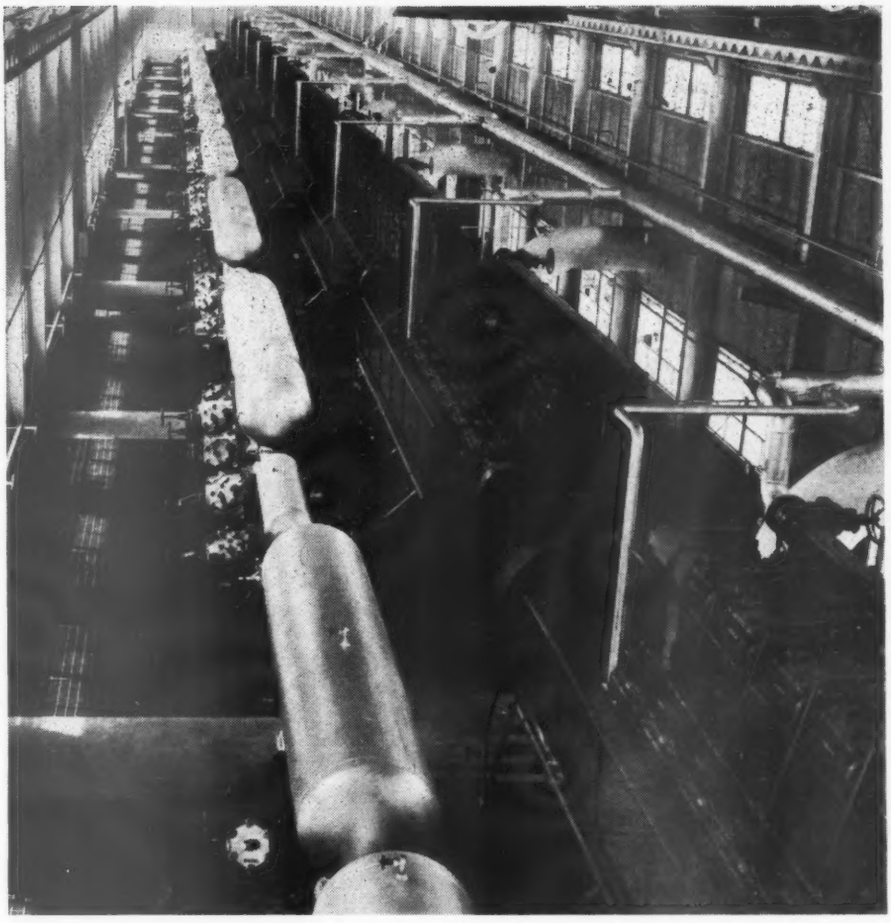
Future addition of four 1600 hp compressors should increase the plant capacity to 120,000,000 cu ft per day.

H_2S Removal System

A flow diagram of the H_2S removal system is shown in Fig. 1. Because of the relatively high content of acid gas (H_2S and CO_2), a "split flow" Girbotol amine system was installed. This system, by utilizing partially stripped monoethanolamine for removal of a large proportion of the acid gas, effects economy in utilities consumption over the conventional amine system.

Sour field gas from the second stage of compression after cooling, is divided and processed in two independent parallel amine systems, each designed to sweeten a maximum of 60,000,000 cu ft per day. Each of the 28-tray contactors is 9 ft by 65 ft and operates normally at 175 psig. Gas leaving the contactors is essentially free of CO_2 and is negative to the lead acetate test for H_2S. When processing 90,000,000 cu ft per day of sour field gas, the total circulation of 30 per cent monoethanolamine for both amine systems is some 1100 gpm.

In this "split flow" process, a portion of the total rich amine stream is stripped completely and returned to the top of the contactor. The other portion, only partially stripped, is returned to the contactor on either the 16th or 12th tray from the bottom. The rich amine is split and introduced into the reactivator at two points. That portion flowing down the top half of the reactivator is only partially stripped, while the portion flowing down the bottom half is essentially completely stripped. Details of the cycle are shown in the flow diagram, Fig. 1.



Interior view of north compressor house. This is one of the world's largest compressor installations devoted to the processing of casinghead gas.

In this process a major portion of the acid gas content of the field is removed by partially stripped amine solution, and further reduction to lead acetate quality is assured by final contacting with completely stripped solution. Elimination of the necessity of completely stripping the entire amine circulation results in substantial reduction of utilities consumption.

Each of the two reactivators is 8 ft-6 in. by 80 ft-10½ in. and is equipped with 33 bubble cap trays, the 17th tray from the bottom being a chimney tray.

Overhead vapor from the reactivator, consisting of acid gas and steam, passes through an overhead cooler that serves to condense the major portion of the steam. Part of this condensate is returned to the reactivator top tray as reflux, and the remaining portion is stripped of acid gas and pumped over wash trays in the tops of the contactors to minimize loss of amine to residue gas. Acid gas from the reactivator reflux accumulator flows to a flare line.

Absorption and Distillation

Sweet rich gas from the third stage discharge scrubber enters two 6 ft-6 in. by 46 ft main absorbers, each containing 25 trays. Normal operating pressure is 693 psig. Design lean oil circulation over the main absorbers for a 90,000,000 cu ft per day processing rate is 585 gpm. The combined residue gas goes to a single diethylene glycol unit for dehydration. Rich oil from the bottom of the absorbers, along with condensate from the third stage scrubber, flows to the reabsorber deethanizer, operated at 137 psig.

The reabsorber deethanizer is equipped with 45 bubble cap trays, 25 in the 10 ft-6 in. by 53 ft stripping section and 20 in the 5 ft by 32 ft absorption section. Rich oil from the main absorber, together with third stage condensate, enters on the 25th tray. Part of the lighter absorbed hydrocarbons flash and rise through the

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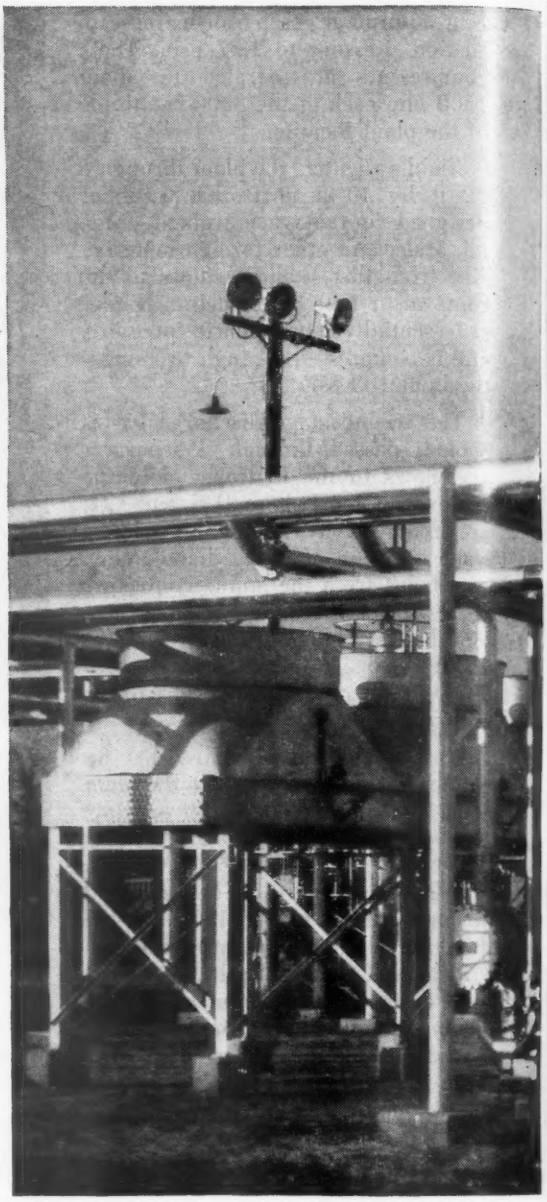

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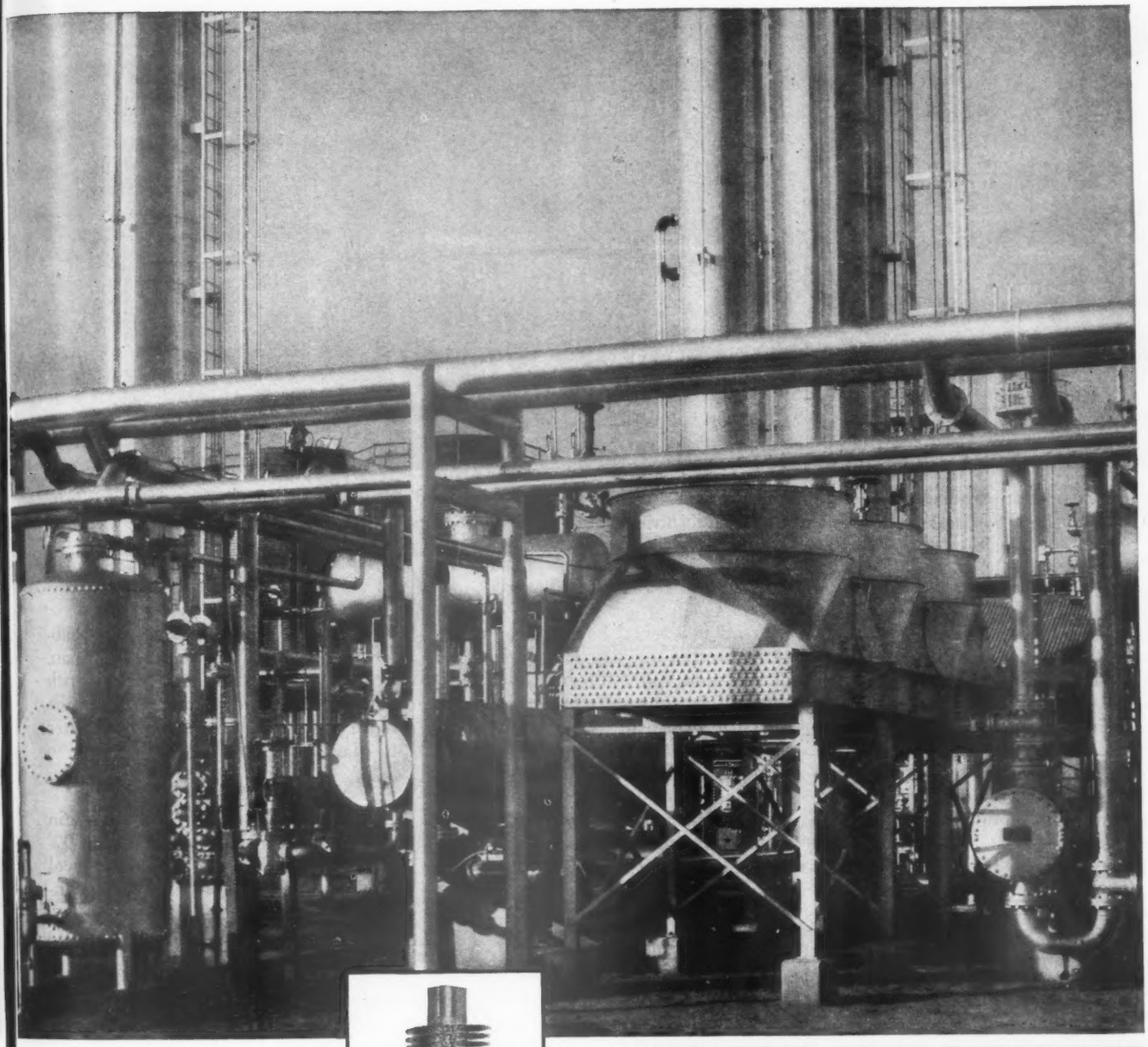

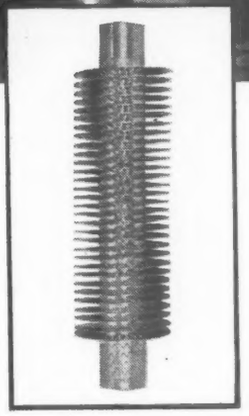

Quality controls of Alco fin-tube manufacture assure highest heat dissipation rate. Fins wound on under pressure and permanently bonded on tube by means of solder bath completely covering fin and tube. Easy to handle, easy to clean with compressed air.

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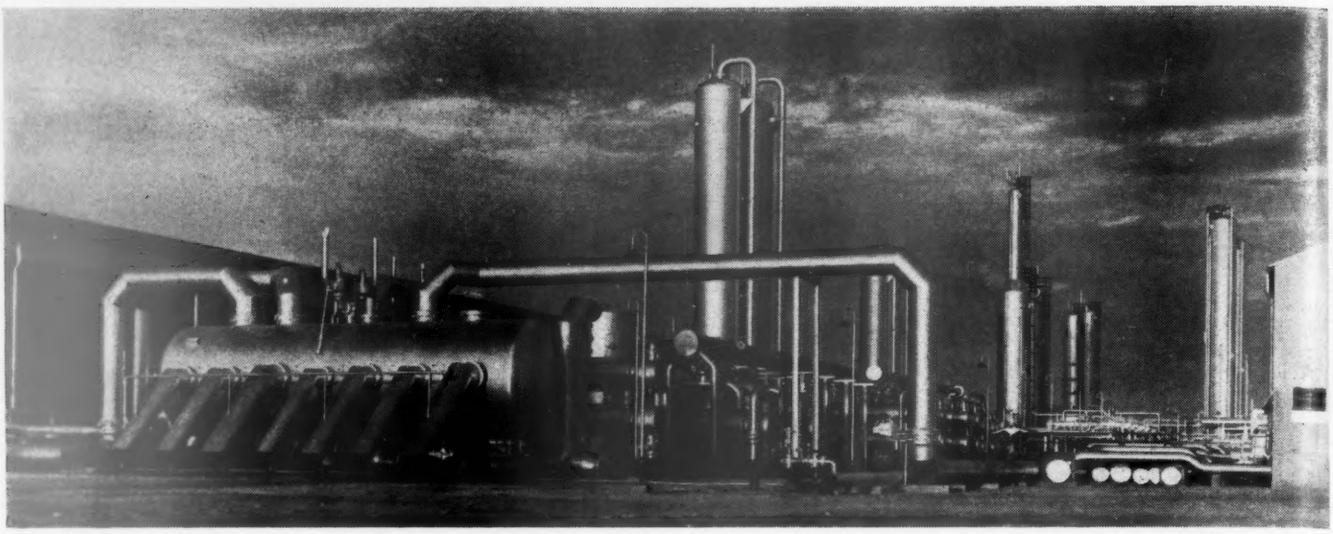


Compressor and absorber area of plant, with process area towers in background. North compressor house is at far left, south compressor house is at right. Plant has sixteen 1600-hp compressors, totaling 25,600 hp.

tower while the remaining rich oil flows down to the bottom of the stripping section. Rich oil from the bottom tray of the stripping section is reboiled by pumping through heat exchangers and is flashed back into a separate compartment in the bottom of the tower. Deethanized rich oil flows from this compartment to the rich oil still.

Flashed vapors rise through the stripping section counter-current to the descending rich oil, effectively removing ethane and methane. Vapor from the stripping section, together with flashed vapor from the feed, enters the 20-tray absorption section where propane and butane loss to the residue gas is controlled by introduction of lean oil to the top tray at a design rate of 155 gpm. Residue gas from the reabsorber deethanizer is used as plant fuel.

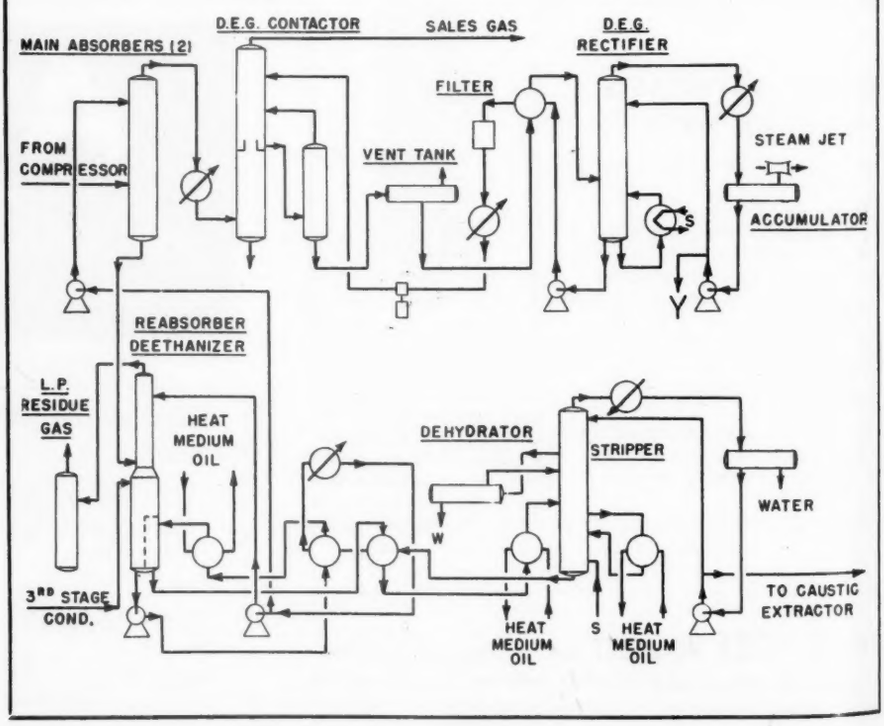
Deethanized rich oil exchanges heat with stripped lean oil, is further heated by heat medium oil to 400 F and enters the rich oil stripper (still) on the 12th tray from the bottom.

The stripper, 9 ft-6 in. by 61 ft-6 in., is equipped with 20 trays. The normal operating pressure is 67 psig. Partially stripped rich oil is withdrawn from the 11th tray of the tower, passes through a reheater and is returned to the 10th tray at 485 F. This oil passes down through the stripping section of the still countercurrent to stripping steam that is introduced to the bottom of the still at a design rate of 9000 lb per hr.

Flashed vapors from the feed, together with stripped vapors from the stripping section, enter the upper or fractionating section of the still where lean oil is washed back by reflux returned to the top tray at a design rate of 230 gpm. Since the rich oil feed to the still is substantially deethanized, the still overhead is normally completely condensed. The overhead make from the still, consisting of propane, butanes and natural gasoline, is pumped through the product treating system to the fractionators.

Hot lean oil from the bottom of the stripper is heat exchanged against the rich oil feed and against the reabsorber deethanizer reboiler stream. The lean oil is finally cooled with water to 85 F and pumped back to the main absorber and reabsorber. Refer to Fig. 2.

FIG. 2. Absorption and distillation—Slaughter Gasoline Plant.



Residue Gas Dehydration

Cooled residue gas from the main absorbers is dried by contact with 97-98 weight per cent diethylene glycol in a 6 ft-6 in. by 30 ft-1 in. 7-tray con-

tactor. The bottom section of this contactor serves as a knock out drum. Normal operating pressure is 688 psig.

Diethylene glycol solution flows from a chimney tray in the contactor through a small level control drum to the rectifier. The rectifier is 2 ft-6 in. by 31 ft and contains 12 bubble cap trays.

In order to permit operation with maximum water dew point depression, provision is made for re-concentration of diluted diethylene glycol vacuum distillation at 8-9 psia. By this method of operation, concentrations of 97-98 weight per cent may be attained without danger of decomposition.

Concentrated diethylene glycol from the bottom of the rectifier is cooled and returned to the top of the contactor. Design circulation rate when processing 90,000,000 cu ft per day is about 10 gpm.

A flow diagram of the residue gas dehydration unit is shown in Fig. 2.

Liquid Product Treating

The high mercaptan sulphur content of the Slaughter field gas makes it impractical to treat the gasoline in a conventional stationary bed copper chloride treater without pre-treatment to reduce the mercaptan content. In the plant, a regenerative caustic washing system serves this purpose. The raw gasoline stream from the still overhead accumulator is pumped through a 6 ft by 50 ft packed caustic contactor containing 30 ft of 1½-in. carbon Raschig rings. When operating at a processing rate of 90,000,000 cu ft per day, the design solution circulation is 35 gpm of 10 per cent sodium hydroxide solution.

This caustic circulation reduces the mercaptan sulphur content of the raw gasoline to a point where it is treated satisfactorily in fixed bed copper chloride treaters. Spent caustic from the bottom of the caustic contactor is regenerated by steam stripping in a 5 ft by 22 ft-6 in. tower equipped with 8 bubble cap trays. The overhead from the caustic regenerator tower, consisting of steam and mercaptans, flows to a disposal stack.

Raw gasoline from the caustic contactor passes through sand filters for removal of caustic entrainment and into five fixed bed copper chloride contactors, each 72 ft by 12 ft, operating in parallel. This treatment converts the remaining mercaptan sulphur content of the raw gasoline to odorless and non-corrosive disulphides.

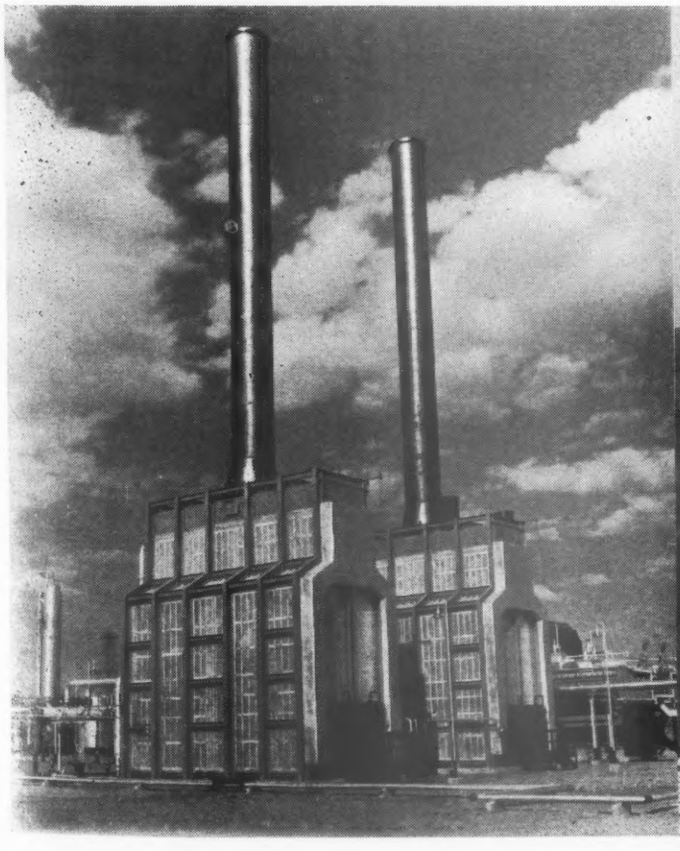
A solid desiccant dehydration unit is provided for propane drying.

Fig. 3 includes a flow diagram of the product treating system.

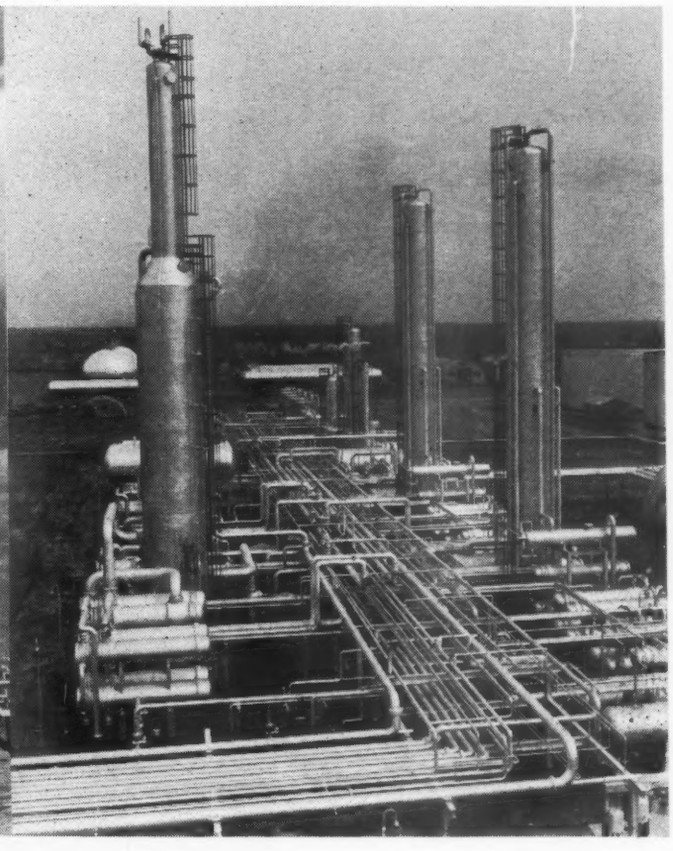
Fractionation System

The treated product stream is heat exchanged with the debutanizer bottoms and pumped into the 36-tray 7 ft by 62 ft-6 in. depropanizer. Commercial propane is produced overhead from this column and flows to storage through a sand filter and solid desiccant dehydration unit. Design operating pressure of the depropanizer is 240 psig. The depropanizer bottom stream feeds the 40-tray 6 ft-6 in. by 68 ft-6 in. debutanizer that normally operates at 75 psig. A commercial butane product is produced overhead and flows through a product cooler to storage. Natural gasoline, which may range in vapor pressure from 12 to 36 lb RVP, is produced as a kettle product. It exchanges heat with the depropanizer feed and flows through a cooler to storage.

Heat medium furnaces of the plant. Most heat for processing is carried by a "heat medium" and oil, heated in these furnaces.



Process area of the plant. Product storage area can be seen in the background, with the rail loading rack beyond.



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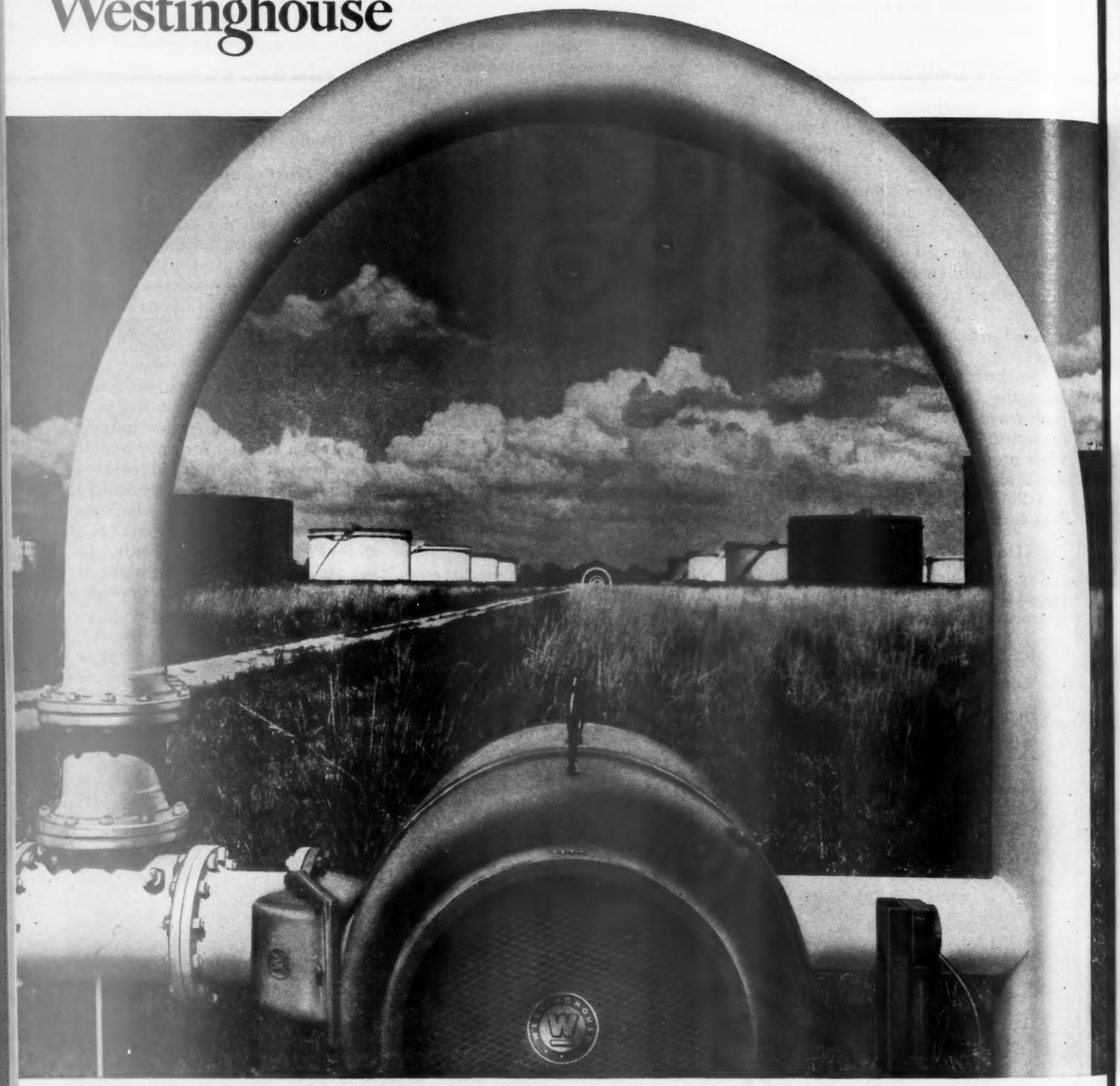

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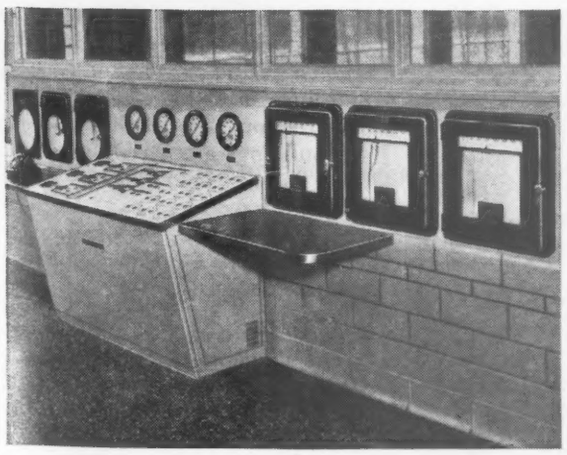
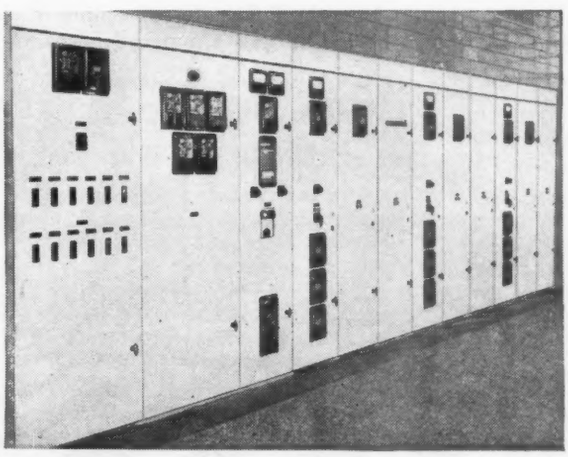


This control desk in a semiautomatic station has flow recorder and controllers for station suction and discharge pressures at left, pushbutton co-ordinated electrical control for pump units and motorized valves in center with pressure gages on panel above, and protective thermocouple recorders at right.



"Unitized" Metal-Clad Switchgear in a semiautomatic pump station, showing (left to right) low-voltage distribution, sequence control for automatic operation of pump units and valves, control of the outdoor main breaker, and reduced-voltage starting equipment for three main-line pump units.

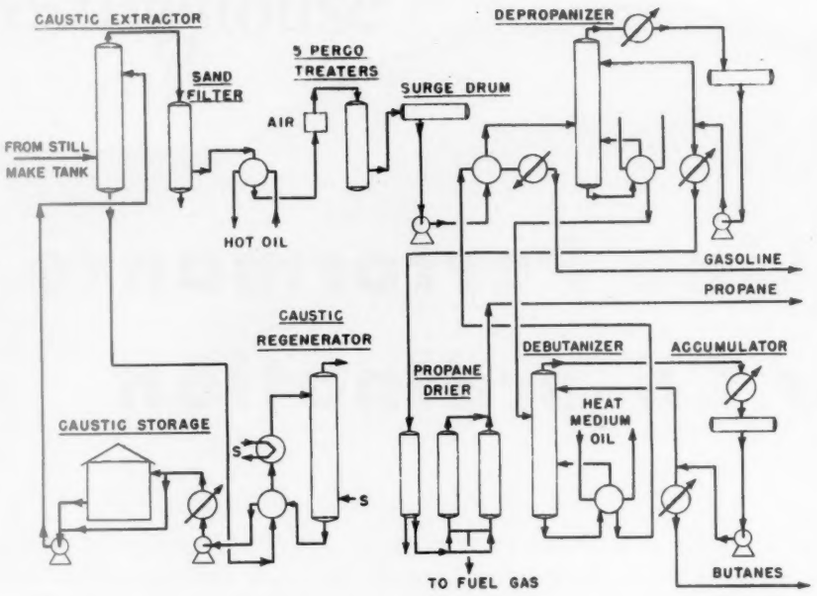


FIG. 3. Product treatment and fractionation—Slaughter Gasoline Plant.

Storage and Loading Facilities

Product storage has been installed for about 5 days' production when processing 90,000,000 cu ft per day. There are three 12 ft by 120 ft horizontal tanks for propane storage, five of the same dimensions for butane, two 7500-bbl spheroids for gasoline, and two 10 ft by 70 ft gasoline rundown tanks.

Storage is also provided for 60,000 bbl of well water, 2000 bbl of lean oil, 1000 bbl of heat medium oil, and 1000 bbl of boiler feed water. There is smaller capacity storage for caustic solution, amine, sulphuric acid and lube oil.

Truck and rail loading facilities are provided at the plant site.

Utilities

In order to hold the steam generation requirements to a minimum, essentially all of the process heating load is supplied by a hot oil heat medium system. Virgin gas oil is circulated through two direct fired heaters, rated at 60,000,000 Btu per hr each, to the various process heat loads. Under design conditions, the heat medium oil leaves the direct fired heaters at 550 F and returns at 360 F.

Process cooling water is circulated over a 20,000 gpm induced draft cooling tower. Under design conditions cold water is pumped from the basin at 80 F to shell and tube exchangers for process, interstage gas, jacket water and lube oil cooling. Water returns to the cooling tower at 120 F.

Raw water is supplied to the plant by four 500 gpm wells located on the plant site.

Electric power is supplied by six 800 kw 2300 v 3 phase generators, each driven by a 1200 bhp (nominal sea level rating) 4 cycle engine.

Steam is supplied at 300 psig by two gas fired water tube boilers, one of which is standby. Each boiler is rated at 30,000 lb per hr. Normal steam demand for a 90,000,000 cu ft per day processing rate is about 22,400 lb per hr. Most of this steam is used to drive the heat medium pump turbines that exhaust into a 125 psig steam system. Steam from this system is used for process stripping, and in the diethylene glycol reboiler and regenerative caustic preheater. Several small turbines are driven by 300 psig steam and exhaust at 10 psig into the hot process boiler feed water treater.

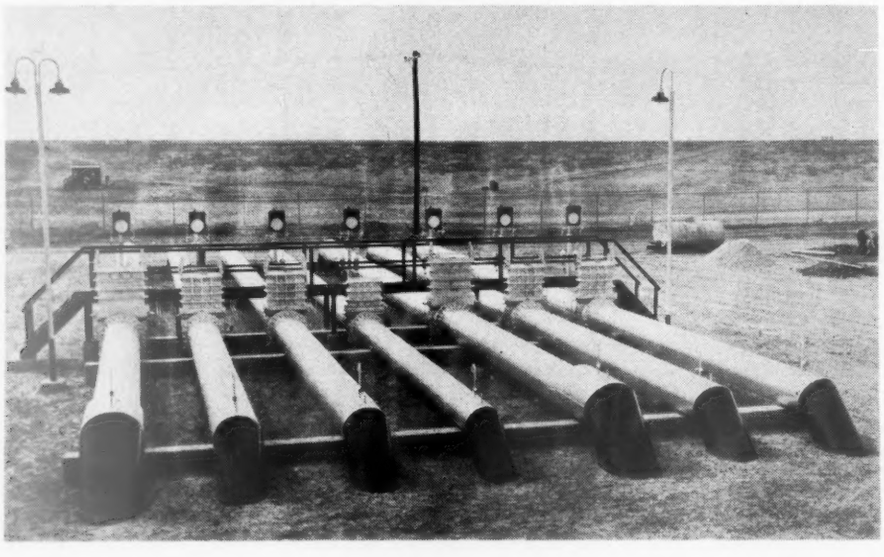
The cold lime-soda process is used to treat cooling water make-up. Facilities are also provided for stabilization by addition of sulphuric acid and for chlorination of the cooling tower water to control algae and slime.

Waste disposal facilities include two 50 ft by 250 ft settling basins, a burning pit, an evaporation pit, a flare stack, and an acid gas stack.

Buildings

There are a total of eight buildings in the plant area. These include two compressor buildings, one 33 ft by 372 ft and one 33 ft by 228 ft; a 53 ft by 170 ft generator building; a 50 ft by 90 ft shop and warehouse; a water treating and chemical storage house; a fire water pump house; a laboratory, and an operators' shelter. The large buildings are of steel rigid-frame construction. The smaller miscellaneous buildings are truss type construction. The roof and walls of all buildings are galvanized corrugated iron. The office bulding is of frame construction and is located outside the plant area.

Casinghead gas from the field enters the plant through the seven big lines that are shown here. The gas is metered here, as it flows into the plant.



☆ ☆ ☆

The Slaughter gasoline plant—a major gas conservation project on the plains of West Texas—was formally opened May 14.

More than 1500 guests attended dedication ceremonies and barbecue at the plant site. William J. Murray, Jr., chairman of the Texas Railroad Commission, was the speaker at the brief opening ceremonies.

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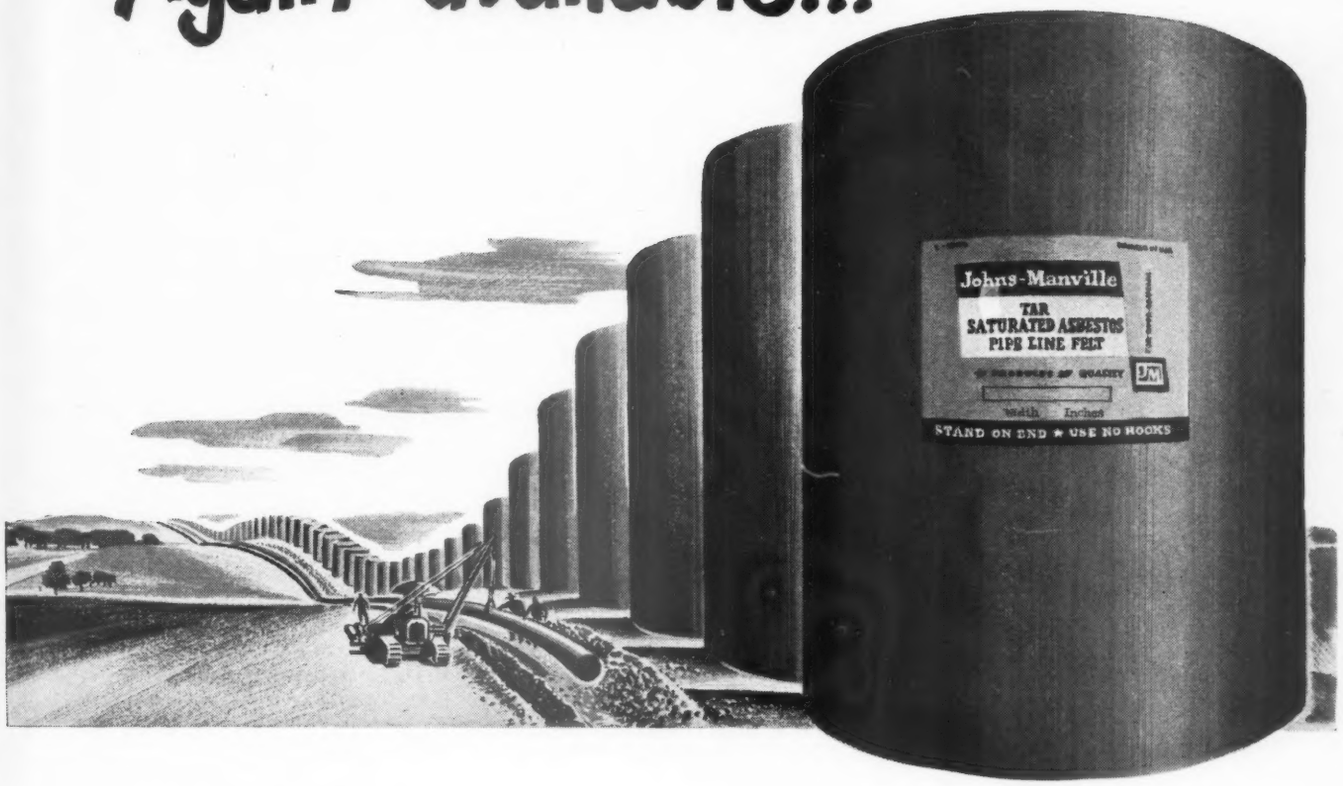

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Petroleum Research*

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In the early days the petroleum industry did not need research in order to make money. There was a tremendous demand for kerosine, in Europe as well as in the United States. The competing products were of poorer quality and were inherently more expensive. Furthermore, because of the previous existence of an extensive industry for making kerosine from coal, there was ready at hand a technology that was adequate for the needs of the moment. Distillation was a relatively old art. Simple refining with sulphuric acid and caustic soda was all the additional treatment kerosine needed.

As a result, research did not again become a real factor until about 25 years after the drilling of the Drake well. In the 1880's the oil industry found itself faced with a new problem.

As the quantity of oil obtainable from the Pennsylvania field diminished and as the demand increased, it was necessary to hunt for oil in other areas. New oil pools were found, but a distressing number of the crudes turned out to be high in sulphur content. They consequently yielded evil-smelling products, and could not be processed satisfactorily by the simple early refining methods. A moderately successful method for correcting the difficulty was invented by Herman Frasch. When the Standard Oil Company (Indiana) was formed, in 1889, to exploit the high-sulphur crude from the Lima, Ohio, field, the new company was provided with the unusual luxury of a full-time research chemist —William M. Burton, who had just received his Ph.D. from Johns Hopkins.

After some early failures, Burton succeeded in making products of satisfactory odor from high-sulphur crude. Burton remained with the company, to work on other problems, but there was no great immediate increase in research. The next big problem appeared 20 years later. About 1909, as automobiles became more numerous, it became apparent that more gasoline would be needed than could be obtained from the available crude.

Burton put his entire research staff, by then consisting of two chemists, on the problem of cracking the heavier portions of petroleum into gasoline. This research resulted in the Burton process—the first commercially successful cracking process. It was also the first commercially important chemical reaction involving aliphatic hydrocarbons—except, of course, combustion. The tremendous financial success of the cracking process was a most convincing demonstration that research was worthwhile.

The gradual trend toward increasing research got another, and most important, boost in the early 1920's when chemical engineering first became a factor in the industry. The advent of chemical engineering marked the real transition to the modern attitude toward research. The research man now became an integral part of the industry, and was charged with the responsibility for examining and improving every operation—even those which were performing satisfactorily.

The raw information with which the chemical engineers worked consisted of heats of vaporization, specific heats, vapor pressures, and other physico-chemical data produced by university research men and by the industry itself. Old processes were improved, and new processes developed. During the early thirties, the industry gradually turned itself into a large-scale example of the latest trends in scientific thinking.

With the introduction of the synthesis processes in the late thirties and early forties, the most recent important step was taken. And so we come to petroleum research as we have it today.

While the change from the old attitude was gradual, it was a real and great change. Research was no longer engaged simply in trouble-shooting but became the guiding principle of the industry—the "planning for the future" element of the business.

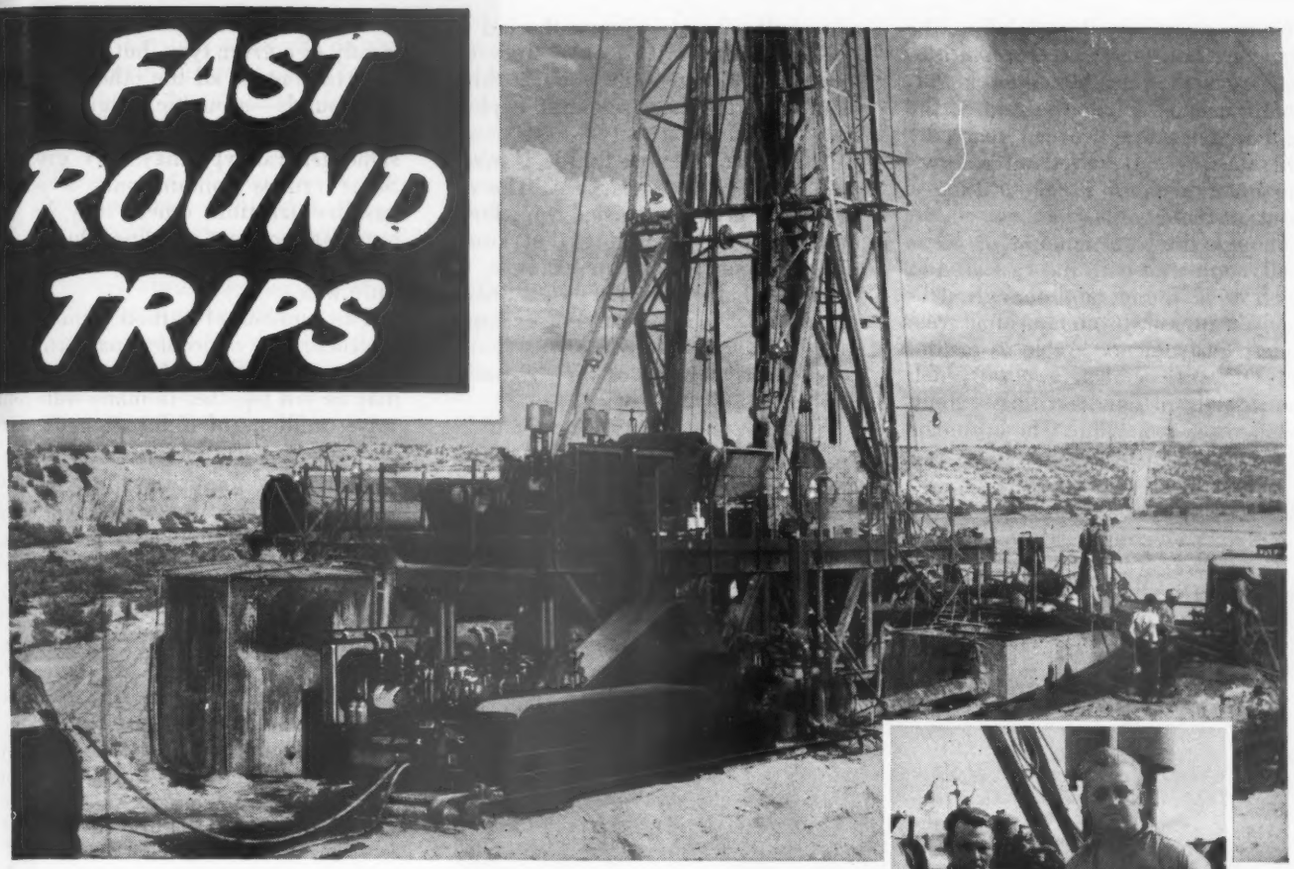
Scientific foresight became increasingly necessary. Processing units began to cost a great deal of money and to take several years to plan and build. The great steel towers you see in the refineries today came into existence not because some past process suddenly became inadequate but because research men, looking ahead two or three or five years, saw a way in which science could be applied still more effectively in the meeting of consumer needs. In some cases the consumer needs themselves existed only in the prophetic minds of the research scientists.

Prospecting for oil has changed since the days when "oil springs" indicated the presence of petroleum underneath the ground. Such promising locations were thoroughly drilled long before the start of the present century. Modern oil exploration makes but little use of surface geology; it relies instead on delicate electronic instruments. Though these instruments operate on the surface, they map the rock formations three miles down in the earth, or even deeper. They do not detect oil, but indicate when the underground rock formations are of the right shape for trapping oil, in case any is present.

These devices are really quite remarkable. The seismograph, used for measuring explosion vibrations reflected from rock strata deep in the earth, will measure movements of the ground amounting to only one millionth of an inch—not a very vigorous artificial earthquake. Another instrument, the gravity meter, actually "weighs" the rocks several miles beneath it. Its operation is based on the fact that the attraction between two bodies varies directly as the product of their masses, and inversely as the square of the distance between them. A known mass is supported on a spring, and changes in the deflection of the spring are measured. The force of gravity can be determined to 1 part in 25 million. Even variations in the buoyant effect of the air caused by changes in the barometric pressure are large compared with the variations in the force of gravity being measured. Effects of the sun and moon must also be considered. Measurement of the magnetic field of the rocks of the earth provides another geophysical tool. An instrument called the magnetometer has been devised, which is so rugged that it can be flown over an area in a plane, mapping the underground structures as it goes!

*Condensation of talk made by J. K. Roberts, general manager of research, Standard Oil Company (Ind.), before the Kentucky chapter of Sigma Xi, University of Kentucky, Lexington, Kentucky, May 5, 1949.

FAST ROUND TRIPS



Emsco GA 500 draw works and Emsco CA 16 mud pump, each powered by two GM Diesel Twin Sizes, drilling to 8000 feet near McKittrick, Calif.

(Left) Clyde Hall, owner Clyde Hall Drilling Co.
(Right) Ray Ferguson, tool pusher for Hall.

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Contrary to popular opinion, the oil we are hunting exists in quantities that are somewhat less than underground oceans. Of the portion of the United States that we can reach by drill, the present proved oil reserves constitute one part in ten million—about one cubic mile.

Though the total amount of oil is small, compared with the vast area in which it is found, and though it is widely scattered throughout that area, modern instruments enable us to find oil. Of our wildcat wells—which means wells in new territory—about one in six is successful. The optimists who drill wildcats without the aid of new physical instruments find oil once in 18 times—only about a third as often as the more scientific explorers.

The crude, when we find it, is made up largely of hydrocarbons. The oil industry may have misled you, however, by oversimplifying that situation. We may speak, for example, of crude as being paraffinic. (Pennsylvania crude is the outstanding example of a paraffinic petroleum.) Or, we may describe a crude as aromatic, naphthenic, or asphaltic.

Actually, the situation is not quite so simple. A crude may be *predominantly* of a given type, but it is almost sure to contain all the other types of compounds—aromatic, naphthenic, and asphaltic. Even crudes of the same general type may vary greatly. Some crudes contain only a small gasoline fraction, others may be almost 100 per cent gasoline. One crude may be waxy, another may contain little wax.

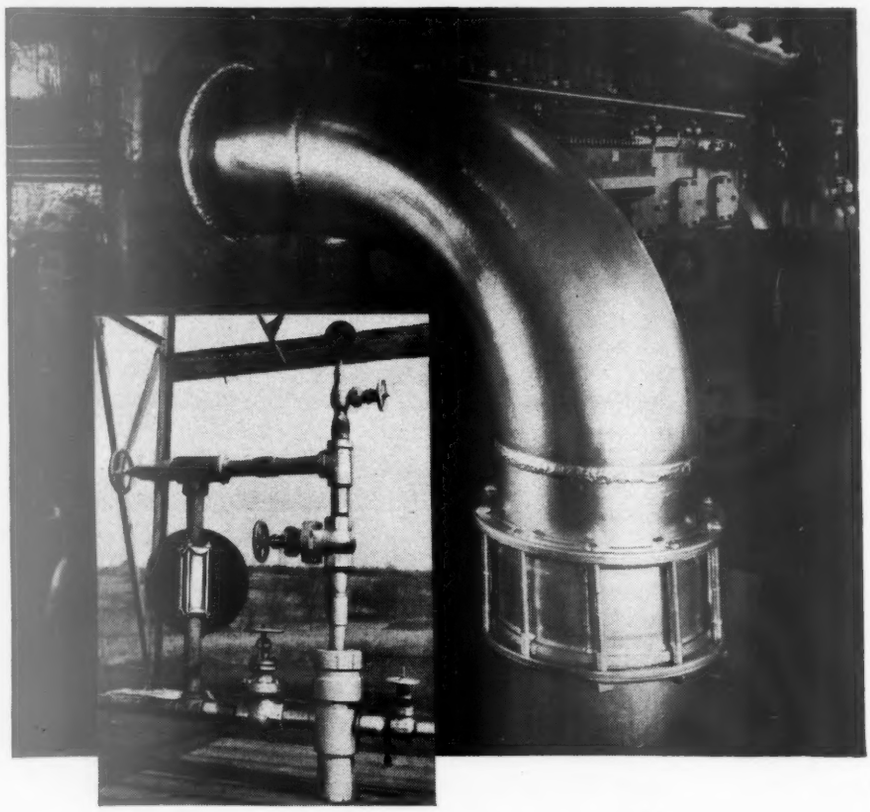
The number of carbon atoms in a hydrocarbon molecule may run as high as sixty. Since the carbon atoms may be put together in many different ways, millions of different hydrocarbons are—or can be—present.

Even the impurities are highly varied, and here again oil men are guilty of oversimplication. We talk, for example, about "sulphur." A little of the sulphur in crude oil may actually be present as such, but most of it is in the form of sulphur compounds. These compounds, like the hydrocarbons, are quite varied. They may be mercaptans, sulphides, ring compounds, disulphides, polysulphides, or thio-ethers. Each class has a different effect on the oil products, and each requires a different method of refining.

Refining Crudes

The great variety of crude oils, and the great variety of impurities, presented a problem that became very real as the oil business grew. Ways had to be found of refining all the various crudes. To make this problem more difficult, inventors kept devising more mechanisms depending on oil products, so that an increasingly large number of different products had to be made. The diesel, designed originally for powdered coal, switched over to oil. Other types of engines learned about the convenience of liquid fuels. Moreover, the quality demanded went steadily up. All the engine designers pointed out that they could increase their power output if the petroleum industry would only give them such-and-such a specially tailored fuel. And there was no helpful similarity in these requirements. Automobile and airplane engines wanted branched and and ring-shaped molecules; diesels greatly preferred straight molecules. This particular situation would have been most convenient, like Jack Spratt and his wife, had it not been that the diesels unfortunately wanted molecules of a *different size* than did the airplanes and automobiles.

As speeds went up, the lubricant requirements also became more stringent. In addition to the increased speeds, it always seemed to turn out that improved gears, such as the modern hypoid gears, had higher operating pressures. They required additives



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to improve the film strength. At the same time, new uses were being found for petroleum by-products—as cutting oils, insecticides, road oils, and food containers, and in many other applications. All of them were important to our way of life and all had critical specifications. It sometimes seemed as if the only oil products the world didn't absolutely have to have were oils for women's face creams, and there was not even complete agreement on that.

So, the oil industry has had to deal with a complex and unpredictable raw material, and it has had to acquire sufficient know-how to make a wide variety of products. In addition, it has had two other problems that make it different from other industries: First, it deals largely with hydrocarbons. Aliphatic or naphthenic hydrocarbons react quite reluctantly, particularly if they do not have anything to react with but other hydrocarbons. Petroleum technologists have therefore been accustomed for a long time to concern themselves with severe operating conditions: high temperatures, high pressures, and highly active catalysts. Second, the petroleum industry must operate under an exceptionally low economic ceiling. The difference between the cost of crude oil, as received at the refinery, and the selling price of the average product made from that crude oil is only six-tenths of a cent a pound. This six-tenths of a cent must cover the cost of processing the material; it must pay the many millions of dollars necessary to build the enormously expensive processing units; and it must leave a small fraction of a cent for profit.

To handle the wide variety of problems, large research organizations are desirable—organizations with considerable flexibility and with a capacity for doing many different types of work.

In our own case, research has indeed become a large-scale affair. In the laboratories of the Standard Oil Company (Indiana) and its subsidiaries are more than 500 scientists, and more than 700 technicians and other laboratory assistants. The scientists may be chemists, chemical engineers, physicists, biologists, geologists, or paleontologists.

The types of work are those which would be expected: exploratory research, followed by pilot-plant work, by studies of process design and economics, and by technical service to the departments that operate the manufacturing units and sell the products. We do a certain amount of basic research, but we feel that such research, in the main, is really the province of the universities or of groups specially set up to do this fundamental work. Groups that have done an especially good job are those engaged in the American Petroleum Institute projects at the National Bureau of Standards and at several universities.

Example of Research

The work we do in our own laboratories is largely applied, though this applied research often turns out to have theoretical significance. A typical example of oil research is the present work on one of the desulphurization methods being studied in our laboratories—the extraction of sulphur compounds by means of hydrogen fluoride.

Chemists may wonder why anyone would be crazy enough to select hydrogen fluoride as an extraction agent. HF is one of the most active of all acids. It is one of the few compounds that will attack glass. And it is exceedingly active in its attack on living tissues. The burns it causes are severe and are slow in healing.

We cannot even claim that HF is the only possible method of desulphurization. There are at least four of five other methods, all of which will do the

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job—some of them at relatively low cost. Nevertheless, from a number of sources—the chemical literature, preliminary experiments, analogies with known scientific facts—came inklings, amounting to far less than a certainty, that HF might prove superior in some instances to other means of removing sulphur compounds. Desulphurization is recognized as an important problem to the oil industry, particularly for the future. The newer crudes, including those found in the Middle East, contain even larger quantities of sulphur than the principal crudes now being used.

As a preliminary to exploratory or bench-scale work with HF, we must obtain exact information about its toxicity, its corrosiveness, and its behavior under heat and pressure. The question of construction materials must be examined thoroughly; these materials must resist not only HF but also the hot hydrocarbons on which the HF will be used.

We must of course find out all we can about what happens chemically during the extraction. Does the HF act simply as a solvent, or does it form a loose chemical compound with the sulphur compounds? Can we recover the HF from the extract, so that it can be recycled to the system? How completely can we remove fluorine compounds from the product? All this is in addition to the usual information about distribution ratios and yields. If the exploratory work is promising—and while the later phases of it are still going on—we build a pilot plant. As the pilot plant will process three barrels of oil a day instead of the liter or so processed in the laboratory, we will handle correspondingly large quantities of dangerous HF. Our precautions must be much more elaborate than they were in the laboratory, where part of the problem could always be solved by the use of an efficient fume hood.

So we find ourselves with a pilot plant three stories high, outside the laboratory building in which the control panels are located. The ground surrounding the unit is filled with crushed limestone; in case of a spill, the HF will be neutralized, and the rock can then be dug up and carted away. Control instruments have no direct connection with the inside of the building; all impulses are transmitted electrically. Workmen going into the pilot-plant area must wear complete rubber uniforms, including a helmet with a plastic window. Before coming back into the building, each man must pass through a shower. And every tool brought back into the building is put at once into a bath of soda.

When this extensive pilot plant has been built and equipped and has been thoroughly tested with harmless materials, large-scale experimental work on HF extraction can begin.

By this time we find, however, that our problem has branched out in other directions. Ought the HF extraction process be used on the gasoline or on the gas oil from which a large part of the gasoline is made? To answer this question, we must extract not one but a number of different sulphur-containing oils, and we must experimentally crack these stocks before and after extraction. This cracking work is done in another complicated three-story pilot plant, operation of which costs a thousand dollars a day. When the cracked products have been obtained, they too must be subjected to various tests. The gasoline is evaluated in the engine laboratory, and the heavier fractions are tested in the more important types of domestic oil burners and in diesel engines. Our whole problem is complicated by the fact that we remove not only sulphur compounds but also a certain amount of other compounds.

By long use of the several pilot plants, sufficient chemical-engineering

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data are obtained to permit the chemical engineers to work out a process design, which the mechanical engineers use in estimating the cost of a commercial plant. With this information, the economics group can for the first time make an accurate comparison of the HF process with other desulphurization processes. It may turn out that HF extraction is more expensive, and that we might as well forget all about it. However, should we find a saving in processing costs of even a hundredth of a cent per pound, this would correspond to $1300 per day in the operation of a 42,000 B/D plant. In other words, large-scale operations justify exhaustive and costly research.

Teamwork in Research

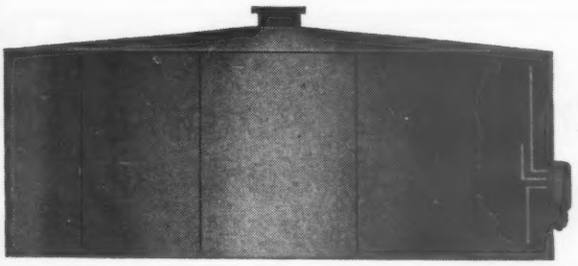
We can hardly carry out research on the extensive and varied scale indicated unless we have cooperation and teamwork from the large staff that is required. This means that a number of scientists must keep their noses fairly close to the grindstone of particular problems. Scientists are by temperament pioneers—at least, if they are good scientists they are pioneers—and pioneers are sometimes not enthusiastic about working on a specific problem, which someone else thought up. The work they do, no matter for what reason they started it, always turns up other leads that look quite interesting. Yet we must insist that certain work be done, because the information it will yield is a vital part of an over-all plan.

This sounds as if our research men are sternly regimented, but actually they are not. They are still pioneers, and pioneers never operate in regiments. We realize, however, that—if not a regiment—we are at least rather a *large group* of pioneers, and so we take certain measures to see that our scientists have maximum freedom.

For one thing, we recognize clearly the psychological truth that perception is conditioned by interest, and we try to put our men on work that will interest them. Here our size is a help rather than a handicap. Since we have a number of different kinds of work, we are usually able to find a kind that will suit almost any scientist. In this effort, we are not restricted to the research department. In fact, one of our duties is to train men for other parts of the company—notably manufacturing but also sales and other activities. People are not moved to other departments, however, simply because they cannot find a type of research that appeals to them. We prefer that the men sent to other departments be men of ability demonstrated by successful accomplishments in our work. An able man with technical training is an asset to almost any department. In addition, it is a help to the research activity to have the company infiltrated with people who understand what research is all about. Most of the people who start out with the research department, however, continue on research. Technicians, laboratory assistants, glassware washers, clerks, and other employees take care of any work that does not absolutely require a technical training.

While research men are encouraged and expected to study the literature, any really major job of this sort is done by a staff of technical people in our information division. They are experts on searching the chemical literature, in a number of languages, and their chief job is to funnel information to our other research people. Their work includes a bi-weekly mimeographed report containing abstracts of current articles and patents. Many of these abstracts are prepared by whichever research man happens to be our leading expert on the subject matter of the article.

In general, we are not convinced that the only information of value to a man is information he obtains the hard way. Taking notes on lectures



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and transcribing those notes into permanent form is unquestionably helpful to college students, whose minds are not always receptive to knowledge; but the spur of competition in business, and the desire to get ahead in the world powerfully increase a man's interest in knowledge. We therefore make the knowledge readily available. If a man has any real use for it in his chosen career, he is apt to seek it. People are encouraged to ask for information wherever in our organization it can be found most easily. Every research man has available a wide range of experts, no farther away than the intra-laboratory telephone on his desk.

In order to have the people working on any particular problem well informed, and also in order to foster highly essential teamwork, we have frequent conferences, in which groups of from three to 20 men get together. As a further extension of this idea, we have annual joint technical meetings with the key technical men of our subsidiaries. These meetings last a week and are held at a resort hotel. About 80 papers are presented, and more than 200 people attend.

No matter wthat type of work they are doing, our technical men never need feel they are simply cogs in a machine. For example, in pilot-plant work, where the effect of a particular variable is being investigated by edict from above, there is opportunity to observe and to think, and therefore to make creative contributions to the work. If a man has a red-hot idea in a field not directly related to his work, arrangements can be made to have his idea tried out by someone else. We have technical men at Whiting whose sole job is to determine the feasibility of invention disclosures turned in by other people. If the idea proves to be a good one, still another type of laboratory specialist enters the picture. When the idea is rounded out through such development studies, appropriate patent applications are filed.

This patent question is one that deserves consideration, and perhaps something should be said about our practices. We pay each inventor fifty dollars for the assignment of a patent application, but we do not have any system of further financial award to inventors. Instead, inventiveness is recognized by salary increases and promotions. Some fields of research obviously offer much greater opportunity for inventions than other fields, and it is not fair to the rest of our staff to grant disproportionate rewards. The research departments of several companies ran into difficulties when they attempted to set up specific rewards for commercially successful inventions, and plans of this sort appear to be on the wane.

We do make every effort, however, to recognize talent. It is of course impossible to say whether there is talent we have missed, but certainly we have found and recognized a large amount of scientific ability. In a large organization, each scientist associates with many other scientists, who become familiar with his work. If his work is good, his scientific colleagues will know it.

A scientist whose work is judged only by business men, on the other hand, is taking a good deal of a gamble. Business men and other laymen can have only one real criterion by which to judge. That criterion is results. Yet in some cases the only possible result of a particular piece of scientific work may be the discovery that the reaction in question will not work. An explorer cannot find a Northwest Passage if there is no passage there. And even while a new process is being developed, still another new process may make it obsolete. Something of this sort happened to us within the past year. Just as our pilot-plant and process-design people

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completed an excellent job on the development of a process for finishing West Texas heater oil, our exploratory-research people announced a new treating process that rendered it obsolete.

It is not necessary for a man to be promoted to an administrative position in order to have his work recognized. Some men are brilliant scientists but have neither an interest in nor an aptitude for administrative work. We have therefore established the title of "research associate" for these men. They are paid salaries comparable with those of our administrative men, and they are given considerable freedom as to the problems on which they work.

Our technical men need not feel tied down in case they wish to leave for other fields of work. It is not unusual for men who do leave to come back and say they have found they were pretty well off with us. Of those who accept other jobs, a gratifyingly high number later ask us to take them back. If they are good men, we do take them back.

Last, but very far from least as regards the contentment of research people, we finally have at Whiting an unusually large and well-equipped place for our research men to work. As a result of all these factors, we have a smoothly-working team.

Basic Training Need

What kind of research men are needed in an organization such as ours? For one thing, a man who expects to make a career of research today should have an advanced degree. This will probably be true to a still greater extent in the future.

As regards type of training, we prefer men who have been trained in fundamentals rather than men who have been given specialized instruction in industrial fields. A year or so ago we had some discussion with one university, which had been deeply impressed by the entirely justified publicity given the fluid catalytic cracking process. The university wanted to install a fluid-catalyst pilot plant, especially designed for catalytic cracking, as part of its course in chemical engineering. We told them this would be exactly the wrong thing for them to do, even aside from the terrific cost.

The place to discover fundamental laws is not on a highly specialized fluid catalytic cracking pilot plant costing a thousand dollars a day to operate. Aside from the university's duty to contribute as much as it can to basic knowledge, it will turn out students that are more useful to industry if it will equip them with a good understanding of the principles behind the various processes. Such students are mentally equipped to handle technical problems that are constantly changing—in the petroleum and in all other industries.

The fluid process is a relatively new industrial technique, useful not only for cracking but for other catalytic processes in various branches of chemical industry. When any entirely new process enters the picture, there arise many interesting fundamental problems connected with it, and these broader problems are just the sort of thing on which a university ought to work. When the Burton cracking process was invented, it immediately created the need for many kinds of basic information—influence of high temperature on tensile strength of metals, methods of measuring high temperature, factors influencing creep in metals, corrosion under entirely new conditions, etc.

Similarly there are many basic problems in connection with fluid cracking. In such a process there are obviously many chemical and physical problems in connection with optimum chemical composition, resistance to attrition, resistance to poisoning, fundamental flow characteristics, erosion characteristics—and many others, all involving fundamental laws.

Benfits to Public

The highly organized and expensive research the oil industry conducts has resulted in some noteworthy achievements. As is generally true of the chemical-process industries, the price of the product has gone down, and the quality has gone up. In 1921 the service-station price of gasoline ex taxes, was 31.4¢ a gal. The octane number of that gasoline was about 55. Today, even with the current inflation, the service-station price of gasoline, ex taxes is 19.5¢, and the octane number is about 80. On this basis the savings to the American motorist in 1948 amounted to more than four billion dollars, without counting the superior performance brought about by the improved quality.

As a result of persistent large-scale research, the petroleum industry finds itself today in an enviable position. Though the world is faced by many serious problems, and the petroleum industry is tied into a good many of them, there is no *oil* problem for which research men do not have an answer. The answer may not be the best one that could possibly be found, but in most cases it is a pretty good one. The industry proved during World War II that it can supply high-octane gasoline, and it can supply even the superfuels needed for the long-range bombers or for the high-compression automobile engines of the future. We hope it will be the automobiles and not the bombers. The nation's entire rubber requirements, if necessary, could be produced by diverting about one per cent of the petroleum output to synthetic rubber. Any organic chemical that can be synthesized can be made, if necessary, from petroleum raw materials—from nylons to toluene for TNT.

Since we seem to have answers for all our problems, you may ask why don't we declare a moratorium on petroleum research? What incentive do our scientists have for carrying on their pioneering work? The answer is, of course, that solutions for our problems are not enough. We must try to find better solutions—ones that will cost the customers less money—because we know that is what our competitors are trying to do.

Scientists want to feel that their work is worthwhile. The competitive research of American industry has definitely been in the public interest. The new products it has created have helped to decrease toil, to increase physical comfort and cultural enjoyment, and to give us military security.

Industrial research must have as raw material the discoveries in basic science made by our independent American universities, and it must of course be manned by the scientists those institutions train. In the combined efforts of university and industrial laboratories lies our most promising hope for raising still further the standard of living of the United States and the world. * * *

Oil Resources to Last

Arno C. Fieldner, chief of the U. S. Bureau of Mines, told the American Mining Congress that America has enough mineral-fuel resources for 100 to 300 years and that "we will have improving conditions of supply for the near future."

As of last January 1, U.S.'s estimated fuel resources, were listed as: 1522 billion net tons of recoverable coal. 200 billion bbl of proved petroleum and natural gas liquids. 174 trillion cu ft of proved natural gas resources.

"Coal production has overtaken demand, as well as petroluem production and importation," Fieldner said.

FIG. 1. Overall view of the torque magnetometer and its control cabinet. The recording instrument is mounted in the cabinet. D. S. Miller of United States Steel Corporation of Delaware's Research Laboratory in Kearny, New Jersey, who developed the new recording torque magnetometer, is shown positioning a sample in the specimen holder preparatory to making a test.

New Electronic Instrument Measures Magnetic Torque

A NEW electronic instrument that measures and records automatically the mechanical torque exerted by a uniform magnetic field on a circular disk of sheet iron or steel to determine uniformity of its magnetic properties has been developed at the Research Laboratory, United States Steel Corporation of Delaware, in Kearny, New Jersey. The recording torque magentometer uses flat steel samples about the size of a quarter dollar. It makes a recorded reading in six minutes.

Two typical practical applications in which measurements of this kind have proved useful are: (1) in testing improved high-grade silicon steels for electrical transformer cores, in which superior magnetic properties are desired in the rolling direction; and (2) in controlling production of tin-plate with uniform drawing properties for the manufacture of such products as bottle caps. In the latter case, magnetic anisotropy, as indicated in the troque test, gives a clue to the amount of prefered orientations present in the crystallographic structure. This, in turn, indicates the extent of the directionality to be expected in the mechanical properties. Hence, the recording magnetometer provides a new tool that will be valuable in studying drawing qualities of steel used in such important applications as automobile fenders and bodies.

While measurement of magnetic torgue is not a new development, in the present instrument the torque exerted on the disk is converted by a resistance strain gage to a small, direct-current voltage that is applied to the measuring circuit of a "strip-chart" voltage recorder of the proper sensitivity. The sample disk is rotated about an axis perpendicular to its plane by a synchronous motor driving through reduction gearing.

The chart paper in the recorder also is driven by a synchronous motor, so that there is a definite relation between the angular rotation of the disk and the movement of the chart paper. As the disk rotates, the torque varies and the pen in the recorder moves in accordance with this variation. By use of the proper conversion factor, the voltage recorded on the chart paper becomes a plot of torque versus angle of orientation of the disk in the magnetic field, using the rolling direction as the reference.

A view of the complete installation is shown in Fig. 1. The unit on the table at the right is the torque magnetometer, consisting of the electromagnet, the torsion gage, the specimen mounting and the drive which rotates the specimen in the magnetic field. The cabinet at the left contains the recorder and the control equipment necessary for operating the instrument. The controls on the top panel permit the operator to vary the sensitivity of the gage. Thus, allowance is made for selection of values of the conversion factor to alter the torque scale on the chart for different types of material, and to compensate for different thicknesses. Controls on a bottom panel in the cabinet (not visible in Fig. 1) provide adjustment of the current through the magnet to regulate the strength of the magnetic field.

As previously stated, one very useful application of the instrument is in testing silicon-steel sheets used in manufacturing the cores of transformers. Within the last 10 years, methods have been developed by which these sheets can be made so that they are much more easily magentized in the rolling direction of the sheet than across it. If a transformer core is made of strips cut from sheet in such a manner that the magentization will be parallel to the long direction of the sheet, the transformer can be made smaller, lighter in weight and more efficient than one of equal capacity made of steel produced by older methods.

Sheet steel having such directional properties would not be satisfactory for the cores of motors and generators, however. For these applications, the steel should be magnetically isotropic. That is, it should have the same or

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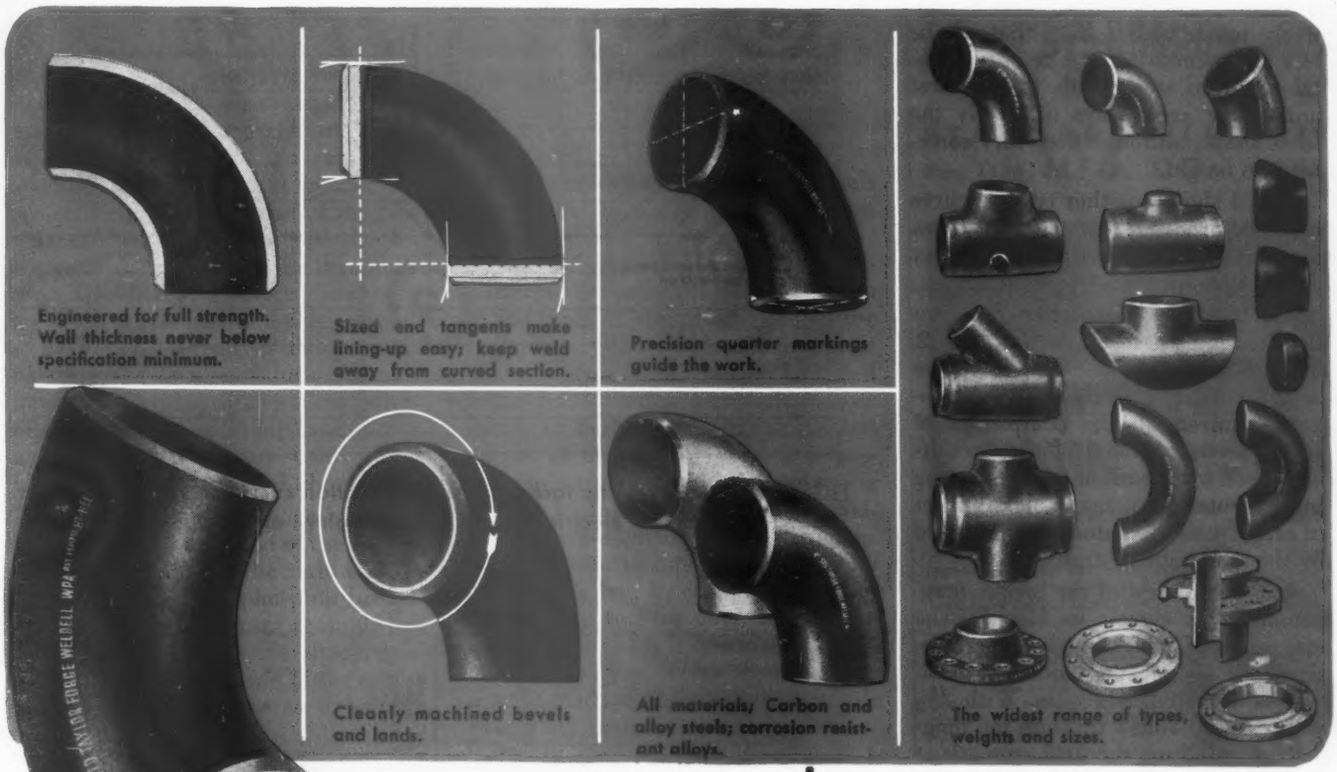
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nearly the same magnetic properties in at least all of the plane directions of the sheet. Measurement of the magentic properties by the torque magnetometer, therefore, provides a quick and simple method of testing transformer and dynamo steels for directional effects. Other types of tests for these effects would require four to five times as much time, and require about 50 times as much steel.

Two typical curves drawn by the recorder of the instrument when testing silicon steels made for electrical equipment are shown in Fig. 2 and 3. Fig. 2 represents the curve for a very anisotropic high-quality transformer steel, while Fig. 3 shows the curve developed when testing a slightly anisotropic intermediate grade electrical steel.

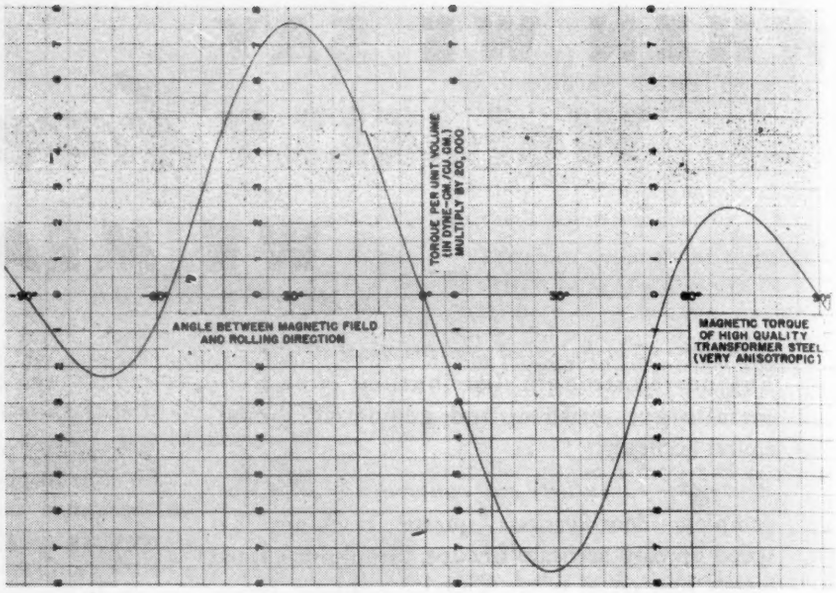
The angle scale on these plots shows the angle between the direction of magnetization and that direction in the sample which is parallel to the rolling direction. It will be noted that the maximum of the curve for the highly directional (anisotropic) steel is relatively much higher than that of the less directional types. The curves obtained from steels with the greatest anisotropy are always of nearly the same shape, although they vary somewhat in height.

Fig. 4 shows another type of curve obtained from testing a plain carbon steel, which magnetically is very nearly isotropic.

The torque magnetometer completes the drawing of curves such as Fig. 2, 3 and 4 in six minutes. This compares very favorably with the 30 to 45 minutes required for the completion of such a curve by hand plotting results obtained with earlier non-recording instruments. Also, many possibilities of error by the operator are eliminated by the automatic instrument.

A close-up view of the torque magnetometer is shown in Fig. 5. The magnet is of rather conventional design. The air gap, in which the specimen is mounted, is 1¾ in. With 2½ amp (at 120 volts) through the magnetizing winding, the field strength at the center of the gap is about 4000 oersteds. The torsion gage, with specimen mount, is that part of the instrument shown between the two magnet coils. It is mounted on a dial plate, 6 in. diam, whose periphery is graduated in degrees of angle.

This dial plate is attached to a shaft which passes through the base of the magnet, connecting to a gear train housed in the pedestal. The synchronous motor which drives the gear train is mounted on the back of the base. The thumb-lever visible on the lower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ANGLE BETWEEN MAGNETIC FIELD AND ROLLING DIRECTION
MAGNETIC TORQUE OF HIGH QUALITY TRANSFORMER STEEL (VERY ANISOTROPIC)

FIG. 2. Curve drawn by recorder of torque magnetometer typical of those obtained when testing high quality transformer steel, which is very anisotropic.

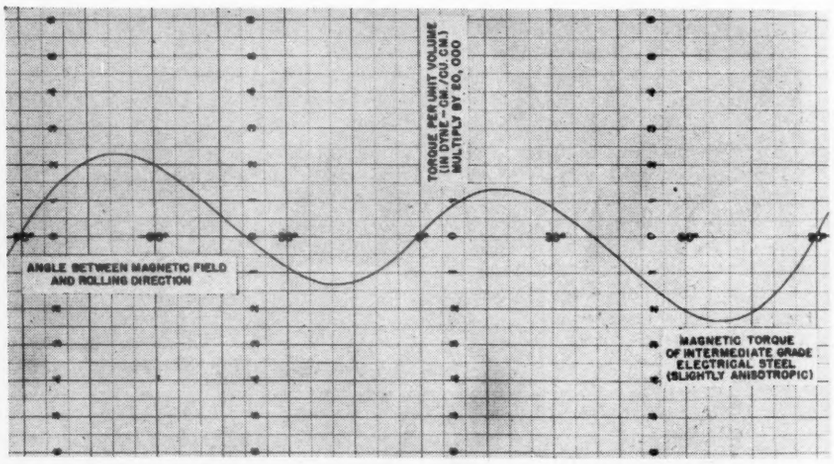

TORQUE PER UNIT VOLUME (IN DYNE-CM./CU. CM.) MULTIPLY BY 20,000
ANGLE BETWEEN MAGNETIC FIELD AND ROLLING DIRECTION
MAGNETIC TORQUE OF INTERMEDIATE GRADE ELECTRICAL STEEL (SLIGHTLY ANISOTROPIC)

FIG. 3. Typical magnetic torque versus orientation curve for an intermediate grade of electrical steel that is slightly anisotropic.

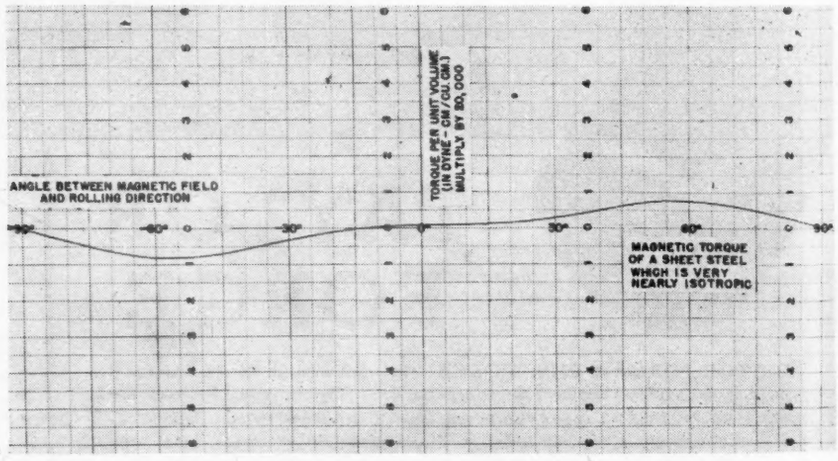

TORQUE PER UNIT VOLUME (IN DYNE-CM./CU. CM.) MULTIPLY BY 20,000
ANGLE BETWEEN MAGNETIC FIELD AND ROLLING DIRECTION
MAGNETIC TORQUE OF A SHEET STEEL WHICH IS VERY NEARLY ISOTROPIC

FIG. 4. Magnetic torque plotted versus sample orientation by torque magnetometer when testing a sample of plain carbon sheet steel is isotropic.

right of the base operates a clutch which disconnects the gear train from the motor shaft to permit free rotation of the dial plate and torsion gage. The cable visible under the left-hand magnet coil connects the strain gage with its direct-current supply circuit and with the measuring circuit of the recorder. The two toggle switches on the right foot of the pedestal control separately the drive motor on the magnetomoter and the chart drive in the recorder.

The torsion gage, with specimen mount, is shown in Fig. 6, removed from its normal position on the base of the magnet. The disk shown in the hand of the operator is the specimen holder in which the disk to be tested is held by spring action of the jaws. This holder fits on the two tapered pins visible at the top of the pedestal. Torque exerted on the specimen is transmitted through these pins to the cylindrical torque shaft shown between the two rectangular uprights. This shaft is mounted between V-jewels in the top and bottom of the rectangular frame.

The rectangular box on the dial plate behind the frame is the resistance strain gage. This device contains four fine-wire resistances under mechanical strain in such a manner that a longitudinal displacement of the pin projecting through the end of the box reduces the strain in two of the resistors and increases it in the other two. The four resistances are connected in a Wheatstone bridge circuit so that displacement of the pin unbalances the bridge. With a current input to the bridge of 25 milliamperes, the output is about 20 millivolts for a displacement of about 0.0015 in., which requires a force of about 4 oz.

The pin of the strain gage is visible in Fig. 6 at the lower end of the torque shaft, between it and the right side of the frame. A fine phosphor-bronze strip is wrapped once around the torque shaft and its ends attached to the two collars on the pin of the strain gage. The strip serves as a belt to convert the torque applied to the shaft to a force on the pin of the strain gage.

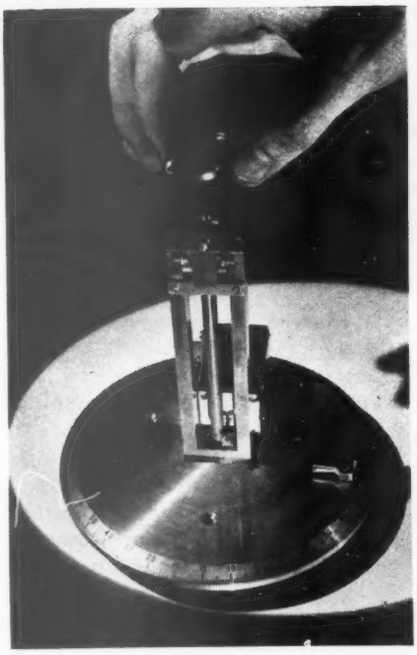


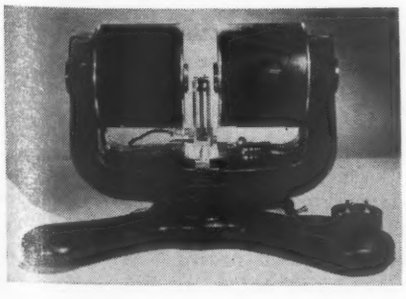
FIG. 6. Torsion gage and specimen mount of magnetometer. Disk in hand of operator is specimen holder, which fits on two tapered pins at top of pedestal. Resistance strain gage is box on dial plate behind frame.

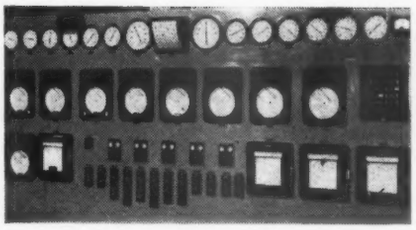
The recorder used with the instrument is of the potentiometer type. Zero of the scale on the recorder is on the centerline of the chart, and the range of measurements is from -4 to $+4$ millivolts. By using a recorder whose range is one-fifth of the maximum output of the torsion gage, it is possible to vary the factor for coverting voltage to torque by a ratio of 5:1. This is accomplished by varying the current input to the bridge circuit of the gage. Then, by using a high current in the torsion gage with specimens from which a low torque is obtained, and vice versa, the recorder may be made of about equal amplitude over a 5:1 range of torque maxima.

The torque magnetometers which have been put into service up until now require specimens 1 in. diam and from 0.010 in. to 0.100 in. thick, but by suitable changes in design specimens of other dimensions could be accommodated. The total torque on a specimen is proportional to its volume, so that for some materials, for example, tin-plate, which are thin and have a low torque per unit volume, it is particularly desirable to increase the diameter in order to increase the effective sensitivity of the instrument.

* * *

FIG. 5. Close-up view of torque magnetometer used in measuring the magnetic anisotropy of steel samples.





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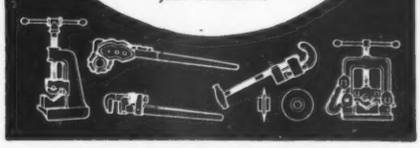

Manitoba and the New Oil Development*

J. R. WHITE

It's time those of us who are interested in industrial development — which means almost everyone in Canada—borrowed a lesson from the educators and psychologists and agriculturists. We should drop the old hickory-stick approach and instead take a really close look at this organism called "business." We should find out what kind of soil and climate and growing conditions it needs, then see what we can do about providing the right setting.

Until we get along a little farther with this new approach to industrial growth, our development, no matter how great it is, will always fall short of what it might have been. We will run the risk of hampering the development of one industry in order to support another. To people in the oil industry, thoughts of this sort are by no means academic; for petroleum is one of the main sinews of industrial development, yet is taxed very heavily in every country of the world. Aside from the more obvious royalties and taxes which add to the retail cost of petroleum, this fuel is the only form of energy that is subject to the federal sales tax. That tax specifically exempts electricity, natural and artificial gas, and fuel, *other than in liquid form.* The two other chief fuels, coal and electricity, are even sometimes subsidized by government, either through some form of freight assistance, or, as is the case with government-owned electrical companies, by exemption from income taxes.

Quite obviously, this policy of singling out petroleum for heavy taxation was not framed with a view to stimulating industrial development. For in a country like Canada, where vast new frontiers lie beyond the reach of the coal-carrying rails and the hydro power lines, petroleum has an exceptionally important role. As such, it can claim some share of the credit for developing Canada's mining industry.

Because of its unusual characteristics, petroleum has become the symbol of our flexible, tremendously productive present-day society. It would be interesting to speculate on how much greater a contribution petroleum might have made if its use had not been subject to heavy taxation! Today, Canadians are using twice as many gallons of petroleum products as they did before the war—about 285 gallons per person, to be more precise. Here in Manitoba, where your prairie farmers use 20 per cent more petroleum than the national average, the contribution of petroleum is even more significant. But we have a good distance to go, since Canadians still only use about half as much petroleum per capita as do the people of the United States. That is why the recent developments in Alberta, with their promise of more abundant supplies, are so significant today.

So far as Manitoba is concerned, two questions seem important — will Manitoba, too, develop its own oil resources? And, how will the growth of western Canadian oil affect the development of Manitoba?

On the whole, the long-term probabilities look fairly good. It is true that the surface rocks of Manitoba are mainly the granites and metamorphics of the pre-Cambrian Shield, rich in hard rock minerals, but lacking the sedimentary formations which carry oil. However about one-fifth of the province, lying in the southwestern corner, is underlain by sedimentary rocks which might contain petroleum.

The actual area of this territory is some 14,000 sq miles and the thickness of the sediment ranges in most parts from about 2000 to 5000 ft. In general, the Manitoba sedimentaries dip gently westward and southwestward into what we call the Moose Jaw Basin. This Basin has been tested by a number of wells drilled in southern Saskatchewan by Imperial Oil, and these tests did not find commercial production of either oil or gas. Nevertheless, many more wells will have to be drilled before southern Saskatchewan, or southwestern Manitoba, are fully prospected. Actually, the geological setting is somewhat similar to southwestern Ontario where a number of small commercial oil and gas fields have been found. In fact, Ontario, has produced upwards of 50,000,000 bbl of oil, or about half as much as Turner Valley is expected to produce.

Although there have not as yet been any very favorable developments, there is a possibility of finding commercial oil or gas fields in the porous sandstones or limestones, since these same formations have been found productive in Alberta and extend across the Basin into Manitoba. Meanwhile, a good deal of exploratory work has already been done in southwestern Manitoba, and more is planned. Imperial Oil has done considerable surface geological work, while other companies have carried out core drilling and seismic surveys. A considerable portion of southwestern Manitoba has been leased by various operators, so we can expect that some drilling will be carried out in the near future. It is also important to remember that a few wells have been drilled in North Dakota which, although not proving commercial production as yet, have made encouraging showings of oil and gas. But for the purposes of immediate planning, the developments in Alberta provide a stronger base than mere hope of production in southwestern Manitoba.

This brings us to the second phase of the question, how Manitoba will fit in with and benefit from the increasing flow of oil from Alberta. Production from the Prairie wells averaged 35,000 bbl daily in 1948. Since then it has increased to a recent figure of 58,000 bbl, and there is every evidence that potential production will mount steadily from here on.

On the other side, Prairie demand was estimated at around 58,000 bbl daily in 1948—a figure which production has now equalled. For 1949, our estimate is that demand will run at something close to 65,000 bbl daily and we expect that western production will exceed this figure, too, somewhere around the middle of the year.

An important factor in the Prairie situation is refinery capacity. Capacity for 1948 was 46,000 bbl, which will be increased during 1949 to 54,000. We expect to see another increase in

*Condensation of an address before the Industrial Development Board of Manitoba, by J. R. White, vice president and director, Imperial Oil, Ltd., Winnipeg, April 8, 1949.

1950—to 61,000, followed by further important additions in 1951. We expect to see 70,000 bbl of refinery capacity in 1951, to meet the growing Prairie requirements. In other words, we look for an increase of more than 50 per cent in Prairie refining capacity over the next three years, and the capacity to produce oil in the west to get ahead of the demand. This means that beginning this year, Prairie oil needs to find markets beyond the Prairie boundaries, so that it will be able to compete in new markets and still bring a reasonable return to the oil producer.

A first step in the program for enlarging the market for Prairie oil is the pipe line, which my company plans to build from Edmonton to Regina. Depending on the number of pumping stations that are installed in this line, it will be capable of carrying anywhere from some 50,000 bbl daily to as high as 120,000 bbl. In other words, this line, at its maximum, could carry approximately twice the present daily output of the western fields, but it will not be finished until the end of 1950 according to our present expectations, and when it is finished, it will only carry the oil as far as Regina.

Now a new oil field, like any other new industry, has to fight for its market. It has to widen the area it serves by pushing back competing sources of crude oil. And this is exactly what is going on in western Canada.

The oil has been flowing out from Edmonton, pushing back costly imports in the process. Shortly, the flow of oil will run into transportation difficulties as it overflows the prairies and further major advances into new markets will obviously have to wait upon the construction of pipe lines. By and large, however, it is apparent that for the next year or so the Alberta oil will *seep* past its barriers, rather than flood out towards new markets.

A good example of this creeping progress was the recent reduction in fuel oil prices on March 15. You may recall that rather substantial reductions were made in the Brandon and Portage La Prairie areas. At the same time, comparatively modest reductions were made for the city of Winnipeg. The reason for this is, that insofar as fuel oil was concerned, Brandon and Portage had been brought within the Alberta orbit, while Winnipeg still remained in the Great Lakes supply area.

Now what I have pointed out so far is all either a matter of record or of planning which has reached the blueprint stage. From this point on, we are

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dealing with possibilities rather than probabilities. I do not believe that the battle which the oil men are waging against distance will stop with the pipe line to Regina. This is really only the first step in the problem. But when it comes to working out the details of the way the future extension of the Alberta market will affect Manitoba, we must keep in mind that we are dealing with a very fluid situation.

In the first place, the price of crude oil is not fixed, and it would be surprising indeed if there were no price changes before the end of 1950 when the line to Regina is scheduled to be finished. In the second place, there is no guarantee that oil reserves will grow at a rate sufficient to justify the further heavy capital investment that would be needed to carry the oil to the major markets of the continent. In the third place, the cost of transporting oil varies tremendously with the amount of oil that is to be carried. And, in the fourth place, there are international considerations which could conceivably have a deciding influence on the direction of the flow from Alberta.

What we are trying to do at this stage of Canada's oil development, is destroy the distance between the oil fields and their markets. The pipe line from Edmonton to Regina is one step in this process. From there, if reserves warrant, the pipe line should probably be extended to the head of the Lakes. In so doing, our present economic data indicate that the line should pass through or near Winnipeg.

If these things come to pass, and once again I emphasize the "*if*," this process will bring Winnipeg a great deal closer to the oil fields in terms of transportation cost. How much this reduction in delivery costs would mean to the price of crude laid down at Winnipeg, it is very difficult even to guess at this stage of the game.

While it is impossible to set figures on the advantages to be gained, the general estimate is that a pipe line would reduce the carrying cost of oil to about one-third of the all-rail rate.

If we made the big assumption that Winnipeg will one day be connected to the Alberta oil field by pipe line, it will mean that crude oil can be delivered much more cheaply at Winnipeg. But, as crude oil is of very little use itself, the real significance of a pipe line to Winnipeg is that it would make it economically possible for that city to become an important refining centre.

As you know, the province of Manitoba has so far not developed very rapidly as a refiner of petroleum. The rated capacity in the province is approximately 5,000 bbl daily, of which some 3,000 is located in Winnipeg, and the other 2,000 at Brandon. Actually, average daily throughput in the Province during 1948 was only 3,588 bbl daily. This is only 28 per cent of the daily demand in Manitoba which reached 12,695 bbl daily during 1948.

There have been two main reasons for this gap between refinery capacity and demand—first, the high cost of delivering crude oil to Manitoba, and second, the fact that the province has offered a somewhat unbalanced market for refinery products. If, however, Winnipeg were connected to the pipe line, crude could be delivered cheaply enough to warrant the extension of refineries at this city. Products which are now sold in comparatively small quantities would presumably become more abundant and perhaps cheaper if there were more refining capacity at work.

In other words, the developments in the west point toward a substantial increase in the refining of petroleum in Manitoba, bringing with it a reduction in the cost of petroleum energy. And since petroleum, for the Dominion as a whole, supplies about 23 per cent of the nation's energy, it appears probable that Manitoba can look forward to a broader and stronger base for her future industrial development. Perhaps the new situation will bring new industries based on petroleum itself. More probably, it will permeate the economy, giving to scores of industries that small margin of added efficiency that may spell the difference between success and failure.

From start to finish, this story is one of a spontaneous response to opportunity. No one used the hickory-stick on the oil seeker to make him find the fields of the west. No one needed to, since favorable geology and the spontaneous demand for petroleum products was spur enough. Nowhere, at any stage of the game was there any compulsion put upon anyone. The entire job has been done by volunteers, not conscripts.

And now we are beginning to see the benefits spread outward from the discoveries in Alberta. And while the problems are different, and the benefits of a less direct nature, the same basic approach will ensure that the oil stimulates industrial growth wherever it touches. As the oil spreads to new areas it brings with it an opportunity and a challenge. In our country the response will be spontaneous—and there will be no need for a hickory-stick.

* * *

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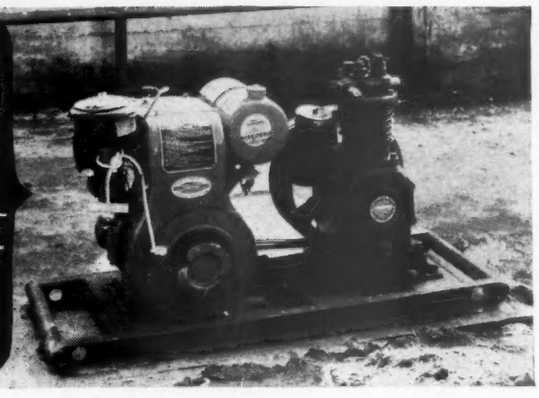

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NEWS

Research Papers Scheduled

Names of scientists and experts presenting papers at the United National Scientific Conference on the conservation and utilization of resources to be held at Lake Success starting August 17, have been announced by Secretary of Interior Krug.

Among those of interest to the petroleum industry are "Review of Techniques for Oil and Gas Discovery" (Airborne Magnometer), James R. Balsley, U. S. geological survey; "Oil From Shale," R. A. Cattell, petroleum and natural gas branch, Bureau of Mines; "Review of Present Status and Future Trends in Oil Chemistry," Dr. Gustav Egloff, director of research, Universal Oil Products Company, Chicago; "Underground Gasification of Coal" (Joint presentation with Milton H. Fies), James L. Elder, chemical and supervising engineer, B. of M.

And "Underground Gasification of Coal" (Joint presentation with James L. Elder), Dr. Milton H. Fies, manager of coal operations, Alabama Power Company; "New Methods, Instruments and Equipment in Oil and Gas Production," Walter S. Hallanan, chairman, National Petroleum council; "Synthetic Fuel Production," Percival Kieth, petroleum engineer, president, Hydrocarbon Research, Inc., New York, New York; "Conservation in Production of Oil and Gas," Wm. J. Murray, chairman, Texas Railroad Commission; "Petroleum Production from Continental Shelves," Mercer Parks, supervising petroleum engineer, Humble Oil and Refining Company; and "Synthetic Fuel Production," Dr. Wilburn C. Schroeder, chief, synthetic liquid fuels, B. of M.

United Distributes Shares

Distribution began May 27 of 5,316,682 shares of United Gas Corporation common stock to former preferred and second preferred stockholders of Electric Power and Light Corporation, it was announced by N. C. McGowen, United Gas president, in Shreveport, Louisiana.

At the end of 1948, United Gas was serving 399 cities and towns and had more than 333,000 customers on its lines in Texas, Louisiana, Mississippi, southern Alabama, and northwestern Florida. Organized in 1930 the firm has built an integrated pipe line system, composed of more than 6000 miles of main transmission lines, more than 7500 miles of distribution and service lines and 1000 miles of field lines. Assets are about $388,000,000.

Propose Stockpiling Lubs for Armed Services

The Pennsylvania Grade crude oil industry is awaiting the reaction of the Armed Services Petroleum Board to a proposal that the government stockpile lubricating oils. The Pennsylvania Grade Crude Oil Association has submitted the proposal in the form of a brief prepared by J. P. Jones of Bradford, Pennsylvania, association director of production, following recent discussion of the matter with board officials in Washington, D. C.

Advantage of such stockpiling was cited as two-fold: It would relieve "an abnormal market condition," which threatens to cause loss of reserves of millions of barrels of Pennsylvania oil through premature abandonment of wells;

Lubricating oil components, now down 50 per cent in price, could be purchased at a considerable saving to the government, thus making available to the armed services "a ready supply of high grade lubricants" as well as "safeguarding future supply of irreplaceable crude stocks to meet our vital defense needs."

Stressed to the military board was the fact that more than two-thirds of current production of Pennsylvania Grade oil comes from secondary recovery operations. As a result, it was explained, the extent to which the producers can bring about a balance of crude oil supply and demand without waste of resources is limited by technical operating factors.

Petroleum Production Pioneers Have Record Meeting

In the biggest gathering yet sponsored by the organization, Petroleum Production Pioneers played host to over 750 oil men, at its spring roundup, May 21. The affair was held at Shell's Barbecue Pit, Brea, California, with Joe Robinson, the Santa Fe Drilling chief, as general chairman, and C. S. "Penn" Penfield, Shell Oil Company, director of arangements. After two weeks of rain and near rain, the weather man smiled sweetly for this occasion and there was nothing left to worry about but food.

Bill Feistner, the well known Shell chef, and his corps of kitchen mechanics, dished up an excellent steak dinner. George Trembley and his elegant "gay nineties" barhops were kept busier than shrew mice at harvest time. And between the two groups the dining and wining was well taken care of.

Busiest of all, however, were Tom Pike and his musical melangers. They had a nice bill all arranged, but the audience decided this was to be a participation program and gathered so closely around the banjo players they could hardly swing their picks.

Leading off in his usual fine style was Chris Christanelli the Baroid concertinist from Houston. Chris is a regular Ezio Pinza or something—anyway, he can sing and play like nobody's business, and is rapidly becoming an institution with the Pioneers. Hugh Glenn, the Emsco prexy, strummed his guitar with rare artistry, and stomped his right foot like a genuine Signal hill billy. Fred Tyler of Reed Roller Bit, whanged enough boogie out of the piano to make Jose Iturbi shake in his shoes; and Tom Pike alternated between the sax and the electric guitar in his anxiety to do the right thing by the boys.

The real unfortunate of the day was Tut Tuttle, the Standard purchasing chap, whose Stradivarius sustained a broken bow and had to be packed in ice all afternoon. Walt Greenfield, the Signal thrush, had a bit of bad luck, too, when his quartet was overwhelmed by some 20 or 30 offkey crooners and finally buried in an avalanche of dissonance.

This party was really attended by the who's who of old time oildom. They swarmed in from New York, Houston, and other out-of-state villages, and were accompanied by many younger men who have also contributed much to the development of the oil industry. Among them we noted such celebrities as A. E. Fowks, Dick Guiberson, looking well after a spell of sickness, Frank Hill, R. C. Baker, W. L. McLaine, Frank Dinger, Dick Smith, George Kammerer, Rene Broomfield, Ed Stearns, Frosty Martin, Elmer Bolton, C. C. Scharpenberg, W. M. Brown, I. T. Cadwell, Clarence Peck, Bill Clark, Julius Dietzel, Julius Lehman, Al Tietze, Bill Forker, Zeb Dyer, Dave Faulkner, John Grier, J. B. Wood, Walter Thompson, W. N. Sutherlen, Frank Skinner, F. C. Ripley, Ernie Pyles, C. E. Priestley, Ralph Porter, Bill Whaley, and so on ad infinitum.

According to Joe Siegel, the efficient membership chairman of PPP, the roster now carries over 1100 names, and there is no evidence of slackening off yet. There is some talk of hiring the Rose Bowl for the next open air party in Los Angeles. That, however, will not be until after the Bakersfield shindig in September.

NEWS

Brazilian Oil Land

The joint United States-Brazil technical commission has warned that Brazil must either open its doors to foreign oil capital or abandon its present program for expansion of air and highway facilities. This conclusion was reached after a study was made as to the possibilities for industrial and other developments in that country. The commission stated that the development of air and road transportation and industry made it imperative that petroleum be explored as soon as possible.

"The present possibilities of Brazil's exports and the country's resistance to import restrictions would appear to indicate that Brazil will be able only with difficulty to maintain the volume of foreign petroleum purchases needed for the expansion indicated," it added. "Consequently, the best method to attain immediate possible results is, unquestionably, to intensify the exploration work."

Japan Dissolves Kodan

The distribution agency, Kodan, has been dissolved and oil marketing in Japan has been turned back to private companies. Kodan was an agency set up by the Japanese government under a supervision of the United States military two years ago. The California Texas Company, Shell Oil and Standard-Vacuum Oil are handling supplies now.

Texaco Fellowship

The University of Cincinnati announces creation of a Texaco Fellowship in industrial medicine, through a grant made to the Institute of Industrial Health in the graduate school of arts and sciences by The Texas Company. This fellowship is being established in the university and the institute, in connection with the training of physicians for practice in industrial medicine and hygiene.

Moves to New York

The scheduled move of headquarters for Arabian American Oil Company from San Francisco, California, to New York has begun. Fifty employes in the personnel department arrived earlier in New York, but the total number that will move from San Francisco has not been determined.

Arabian American is owned by Standard Oil Company of California, The Texas Company, (New Jersey), and Socony-Vacuum Oil Company.

Texas Passes State Unitization Bill

Texas Legislature passed its first oil unitization law May 11, after wrangling for years on the subject. Unitization of gas fields already is legal.

While the "compromise" mustered a legislative majority, it underwent bitter opposition to the end.

Rep. R. E. Blount of Big Spring charged that "big independents are selling little independents down the river" by agreeing to the unitization law.

Operators, particularly major companies, have expressed fear that joining conservation projects might subject them to prosecution under antitrust laws. The bill provides "reasonable exceptions" to antitrust laws to protect conservation.

The Senate failed by one vote to bring up the controversial gas measurement bill. Already passed by the House, it would prescribe a legal definition for "cubic foot of gas."

Passing the house by a vote of 75 to 54, the bill was drawn up in its final version by the house committee on oil and gas. Representatives turned down all amendments to the pooling plan recently passed by the Senate.

Heavy Crude Prices Cut Further in May

The month of May brought price reductions in low gravity crude oil used chiefly for making heavy fuel oil. Despite sharp reductions in crude production and refinery runs, the price drop continued. From California to Texas to the Eastern states, reports of lowered crude prices have come in, with one of the larger companies averaging a 40 cents per bbl reduction, as compared with other companies' 12 and 14-cent reductions.

Along with cutting of crude oil prices, came news that one company has cut the price of its kerosine between 4/10 and 8/10 cent a gal. On the East Coast gasoline prices were upped ½ cent a gal. In the Mid-Continent area they have slipped about ¾ cent since December.

However, in scattered areas, there have been a few cases of gasoline price war carried on in certain midwestern cities.

All companies announcing price reductions for the "fuel oil" type crudes attributed the cuts to declining fuel oil prices and weakening market conditions.

Urges Curbs on FPC

A resolution has been made and adopted by the Interstate Oil Compact Commission, urging legislation barring the Federal Power Commission from taking jurisdiction over production and gathering of natural gas by independent operators.

The commission requested enactment of measures to "make certain that the jurisdiction of the Federal Power Commission does not extend to or include the production and gathering of federal natural gas or the facilities used in connection with the arm's length sales of gas made by a producer and gatherer to a 'natural gas company.'"

O. C. Bailey, El Dorado, Arkansas, compact representative, has stated that production of oil and gas is so intermingled it is impossible to separte regulation of the two, and if FPC controls gas production or gathering it affects state regulation of oil. B. A. Hardey, Shreveport, Louisiana, former president of the IPAA, told the committee some operators think proposed control by FPC of independent gas sales is only a step toward regulation of oil production.

Gasoline Taxes

Automobile drivers burned 30,646,486,000 ballons of gasoline in 1948 and paid taxes of $1,802,675,690 for the privilege.

States colected $1,324,973,000 in gasoline taxes; the federal government $459,702,690.

The gasoline consumption was 8 per cent above the amount used in 1947, the Federal Works Agency reported.

The 1948 gallonage does not include 4,598,301,000 gallons on which tax either was not paid or was paid at a reduced rate because the fuel was used for government or non-highway purposes.

The average gasoline tax per gallon in all states was 4.35 cents in 1948 compared with an average tax of 4.25 cents in 1947. Gasoline taxes ranged from 2 cents in Missouri to 9 cents in Louisiana. Federal tax is 1½ cents per gallon.

According to figures of the API, the average tax on gasoline in the United States is slightly more than 6 cents a gallon and has been for several years. The gasoline tax is only part of the tax load on automotive transport.

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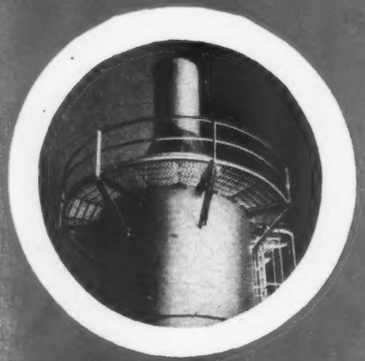

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New members: L. T. Ratliff, W. H. (Bill) Sargent, and R. L. Gollum.

Speakers Lt. Gen. Ira Eaker and W. H. Sargent

Los Angeles Nomads Induct New Members

Ira Eaker, Hughes Aircraft Company, and W. H. "Bill" Sargent of the Sargent Engineering Company, were guest speakers at the May meeting of the Los Angeles Chapter Nomads. The event took place at the Jonathan Club, Los Angeles, California, with a total of 123 persons present, including an unusually large contingent of guests from foreign fields.

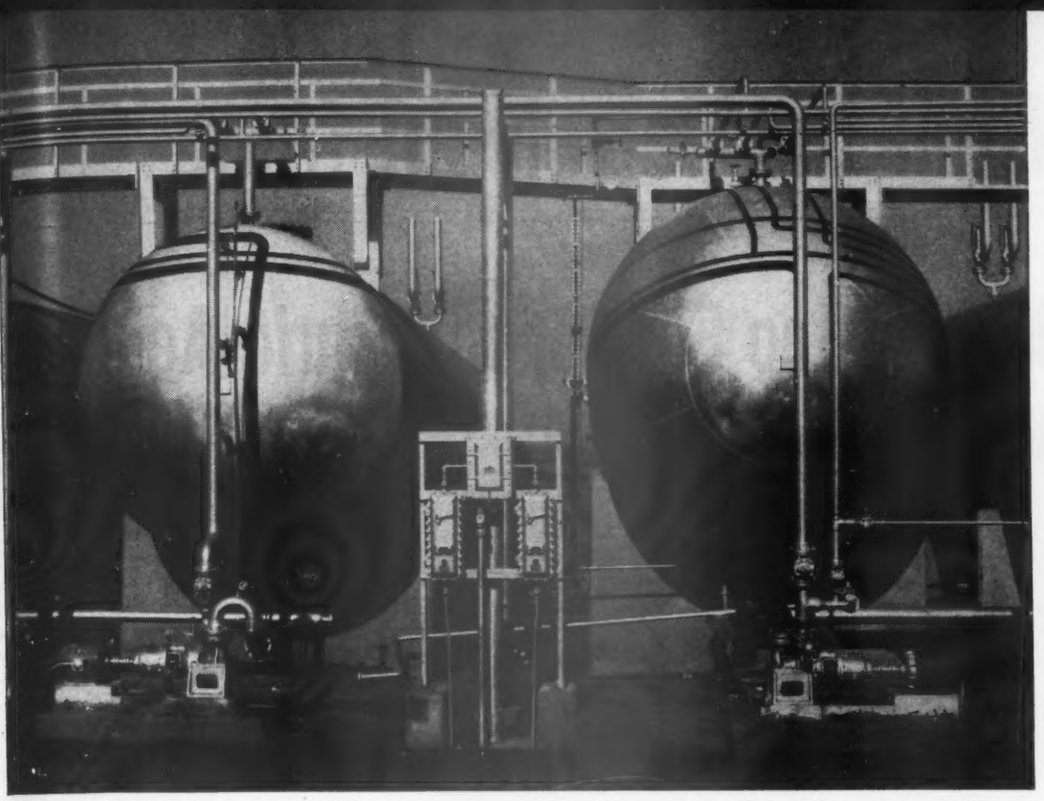
Members heard a report from Earle Boggess to the effect that two former officers of the Los Angeles Chapter—Bob Eiche and Fred Ripley, Jr.—had been selected by unanimous vote to serve as chairman and secretary-treasurer, respectively of the national organization.

W. R. "Frosty" Martin, induction chairman for the evening, welcomed four new members into the Chapter. Those accepting their shingles and pins were L. T. Ratliff, Mid-Continent Supply Company, Los Angeles; W. H. Sargent, Sargent Engineering Company, Huntington Park; R. L. Gollum, International Cementers, Inc., Long Beach, California; and James Whittaker, Christianson Diamond Products, Salt Lake City, Utah.

Sargent, following his induction, discussed the prevailing decline of equipment demand in the South American market. This appraisal he based on evidence gathered on a recent junket through several of the principal oil producing areas in the Latin-Americas. Among the many factors he cited as being responsible for the current sales recession were: the curtailment of heavy crude production, the importation of less costly Middle East oils, high taxation, and increased warehousing costs.

As a fitting climax to the evening's entertainment and education, General Eaker presented some slants on Russia and its people based on contacts and experiences with them during the war.

Guests were, above: Standing—Paul Molidor, Standard Oil (NJ), Colombia; J. R. Grove, Nathsingh Oil Company, Ltd., Burma; A. L. Owen, Iraq Petroleum Company, Kirkuk, Iraq; A. T. Gano, Creole Petroleum Corporation, Caracas, Venezuela; A. J. Dodini, Bahrein Petroleum Company, Ltd., Bahrein. Seated—C. H. Vincent, British Malahan Petroleum Company, Seria, Borneo; P. F. Owings, Iraq Petroleum Company, Kirkuk; G. H. Atkins, Creole Petroleum Corporation, Caracas, Venezuela. Below: Standing—M. R. Teague, Standard Oil (NJ), Egypt; D. E. McGehee, Standard Oil (NJ), Egypt; G. H. Patterson, Aramco, Dhahran, Arabia; John H. Lewis, Drilling and Exploration Company. Seated—Mike H. Bush, Richmond Exploration, Venezuela; J. S. Ramirez, American Overseas Petroleum; R. B. (Bob) Loughboro, Aramco, Dhahran.



Two 2½ HR I Worthington Centrifugal Pumps in LPG loading service at Skelly Oil Co., Velma, Okla.

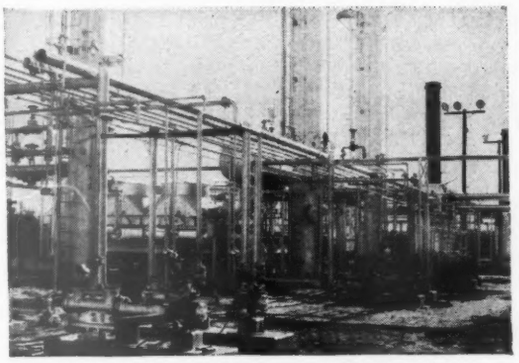
New Arrivals at Skelly Doing Fine

During 1947 and 1948, the Skelly Oil Co., nationally known producers and refiners of oil, installed 8 Worthington Hi-Vols and two Worthington centrifugal pumps in their Velma, Oklahoma plant.

The 8 Hi-Vols (6 x 5 x 12 AO and 8 x 5 x 12 AO) handle Ethane and Hydrocarbons on transfer and still charging in a gasoline plant. Discharge pressures and suction pressures of each pump are 475—525 psi and 100—260 psi, respectively.

The centrifugal pumps are used on LPG gasoline loading service, pumping light Hydrocarbon and Diethyline Glycol with discharge ratings of 525 and 575 psi respectively.

All pumps are in excellent operating condition according to plant officials.



Worthington Hi-Vol Pumps at Skelly Oil Co., Velma, Okla.

First Again With Petroleum Men

Worthington Angle Compressors at Warren Petroleum Company's plant in Holliday, Texas.

The Warren Petroleum Co., the world's largest marketers and manufacturers of natural gasoline and LPG, have recently added two new Worthington LTC 800 hp Compressors to their compressor line-up at the Gasoline and Pressure Maintenance Plant in Holliday, Texas.

The photograph shows a view of eight Worthington LTC Angle Compressors representing a total of 5,200 hp, for handling wet gas and repressuring. All gas is processed before final discharge pressure of 800 pounds per square inch.

Installation of Worthington machinery began in 1946. Performance has been so excellent, that when officials decided to increase capacity, it was Worthington again that got the order!

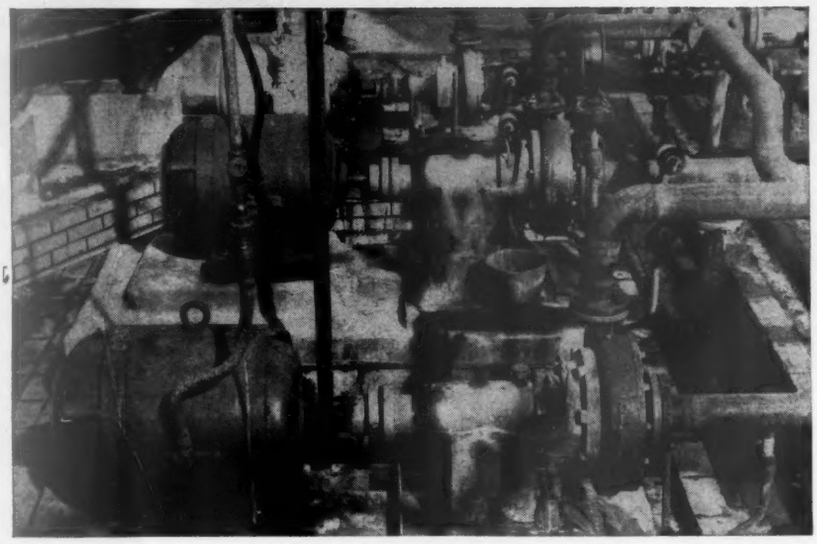
0-7

NEWS

FROM THE PETROLEUM FRONT

AS REPORTED BY THE DEVELOPMENT ENGINEERS, FIELD SERVICE REPRESENTATIVES AND CUSTOMERS OF WORTHINGTON

Nothing too Fat For Sulphuric Acid



Worthite pumps and valves handling 90% sulphuric acid at Esso Standard Oil Co., Baton Rouge, La.

Esso Standard Oil Company at Baton Rouge, La. installed two 2-CG-3 Worthite Centrifugal Pumps to deliver 90% spent sulphuric acid via pipe line to adjacent Consolidated Chemical Industries plant, where acid is fortified and pumped back to the oil refinery for re-use. Worthite is a machinable, high strength alloy steel containing about 52% alloying elements (nickel, chromium, molybdenum, silicon, copper, manganese).

The pump in the foreground of the photo is equipped with a mechanical seal developed by Worthington. This seal has the unique advantage of resisting corrosion and preventing leakage at the stuffing box, thus eliminating the necessity of valve manipulation to control drip. The seal is effective whether the pump is operating or not.

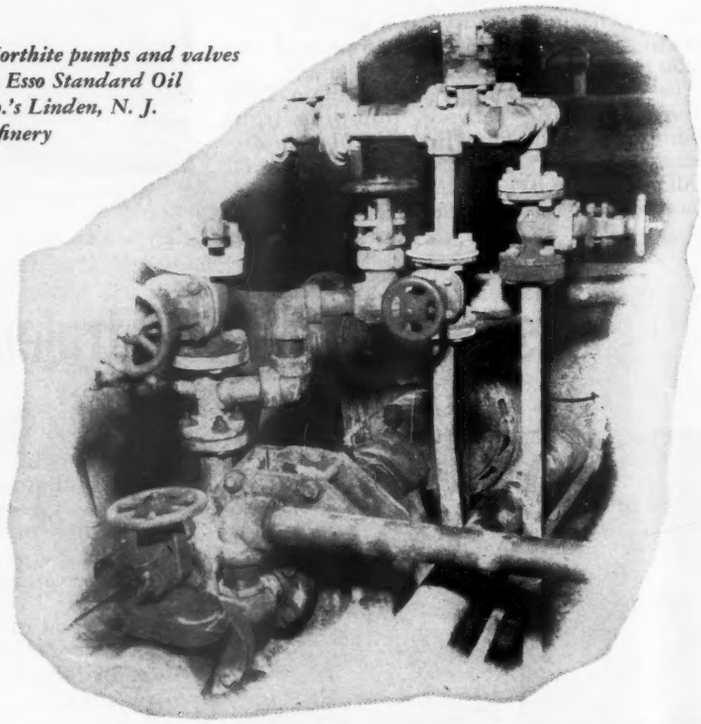
How Esso Handles Fuming H_2SO_4 (Oleum)

The advantages of Worthite for handling .98 to 105% H_2SO_4 has been demonstrated by nine years experience with Worthite pumps and valves at Esso Standard Oil Company's plant in Linden, New Jersey.

The leakage of Oleum from a pump stuffing box could create a very serious problem. Where pressure exists on the pump inlet this problem is much more serious. Conventional use of a water seal is impractical due to the chemical reaction. This problem was solved by throttling a valve in the suction line to create a pressure below atmospheric at the pump suction. The packing in the pump stuffing box now has a much easier function, that of preventing inleakage of air, and gives satisfactory service.

The valves used previously on this service were plug cocks which tended to stick or freeze up, often requiring the use of a six foot bar wrench to turn. This difficulty was overcome by using Worthite gate valves, as shown in the illustration. The Worthite gate valves turn freely and have given many years of trouble-free service.

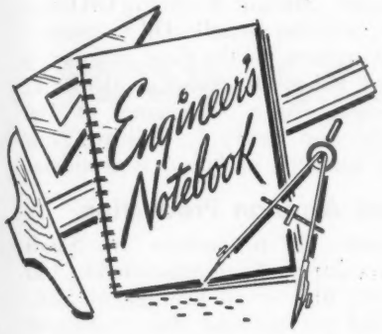
Worthite pumps and valves in Esso Standard Oil Co.'s Linden, N. J. refinery



The development of the mechanical seal for Worthite Chemical Pumps has further simplified the solution of the stuffing box problem when pumping Oleum. The seal automatically stops stuffing box leakage without adjustment or throttling on the pump suction. An installation in a chemical plant using the seal has given nearly a year of service without leakage or adjustment.

Worthington Pump and Machinery Corporation
Harrison, N. J.

NEWS

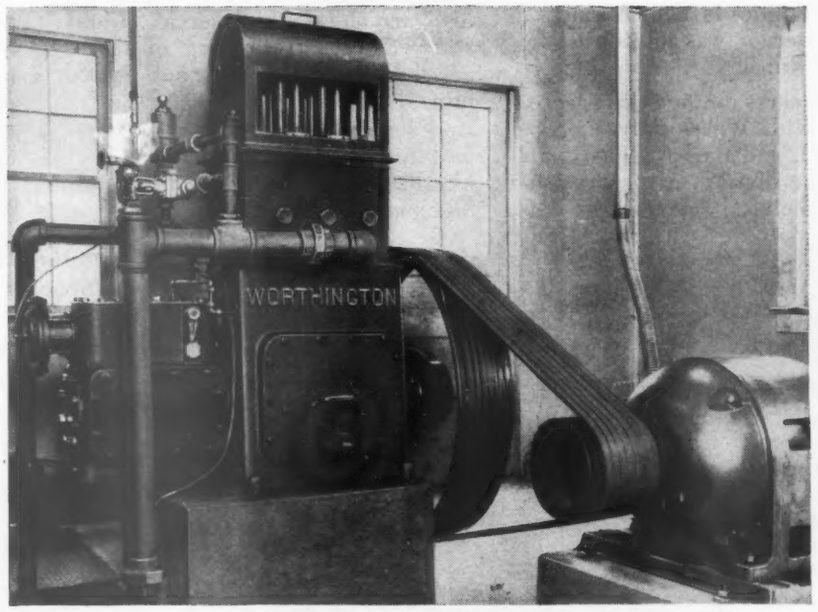


Worthington Pumps for Product Pipelines

The application of pumping equipment to product pipelines requires that special consideration be given to the means used for varying capacity to obtain the maximum through-put at all times.

With the wide variety of products handled in a product line, a maximum through-put can be obtained only when pumping the lightest product, if the operating pressure remains constant. When heavier products having higher viscosities are pumped, the pipe friction due to the greater viscosity increases, and the volume pumped must be reduced if the line operating pressure is to be maintained at the design value. The advantages which are obtained by automatically varying the pump capacity to maintain the desired line pressure are obvious. Stepless capacity control obtained automatically will result in the greatest possible through-put, regardless of the products or combination of products being handled.

The Worthington Automatic Variflo power pump is ideally adapted to this type of operation. Capacity variation is obtained by a very simple mechanism built into the pump crankshaft, and functions on the principle of changing the eccentricity of the cranks at each plunger location. Use of a standard pneumatic type pressure governor provides automatic capacity control from 0 to 100% by adjusting the pump stroke to maintain the discharge pressure constant.



Variflo Variable Capacity Pump

VTE Fixed Stroke Pump

Variation in line capacity between light and heavy products will depend upon the particular pipeline under consideration. Generally, the maximum variation in through-put will rarely exceed 30% of the maximum line capacity. In certain cases, this makes it possible to install part of the pumping equipment in constant stroke constant capacity pumps, reducing the cost of the station. The Worthington fixed stroke VTE pump is identical with the automatic variable capacity Variflo pump, except for the crankshaft and stroke changing elements. All parts normally subject to replacement are therefore interchangeable between the two types of pumps. When the maximum volume handled by the pipeline exceeds the capacity of a single pump, a combination of Variflo and VTE pumps may be installed without sacrificing interchangeability of parts.

For example, a pipeline operating at 850 psi may be able to handle a maximum of 8000 barrels per day of gasoline, but can only handle 5600 barrels per day of #2 furnace oil, without exceeding the design pressure of 850 psi. One 4000 barrel per day constant capacity, constant, stroke, VTE pump and one 4000 barrel per day maximum capacity variable capacity Variflo pump can be used. The constant capacity pump would operate continuously at 4000 BPD and the variable capacity pump would automatically adjust the capacity of the station within the range 5600 to 8000 BPD and maintain 850 psi discharge pressure.

Furthermore, changes in viscosity and specific gravity, with changes in liquid handles, do not affect the power pump efficiency and maximum efficiency is maintained throughout the operating range of the pipeline.

Capacities up to 5200 barrels per day at pressures of 850 psi can be obtained from the VTE and Variflo Triplex Plunger Pumps.

In addition to pipeline service, the Variflo pump has many other applications such as: boiler feed, process charge, desuperheater feed and water flooding operations.

NEWS

Pacific Coast API Holds Annual Meeting

The 22nd annual spring meeting of the Pacific Coast district, API, division of production, was held recently at the Biltmore Hotel, Los Angeles, California. It has been estimated that some 1200 persons listened in on the technical program, and well over 1000 were at the banquet to hear Lt. Governor Goodwin J. Knight discourse on the topic, "Politics Is Your Business." The Lt. Governor was introduced by A. C. "Cy" Rubel.

Other speakers on the banquet program were R. L. Wheelock, vice president of API, and Carl A. Young, director of the division of production. Officers of the local chapters also tendered their annual reports, and scrolls were presented to a number of outstanding and long term members for exceptional service. These were Carl Young; C. C. Scharpenberg, Standard of California retired; W. G. Corey, perennial district treasurer; Lot Bowen, Western Gulf Oil Company; M. B. Standing, California Research; and Don Hall, McCullough Tool Company. During the evening, L. L. Aubert, Bankline Oil Company, in behalf of the district members, presented Bill Corey two pieces of traveling luggage as a token of their regard for his long and faithful service. Corey received a heart-warming ovation—a well deserved one, for he has devoted himself zealously to the API cause since he first became district treasurer back in 1931. He will be succeeded by Charlie Reichert, National Supply Company, Torrance.

Subsidiaries Merged

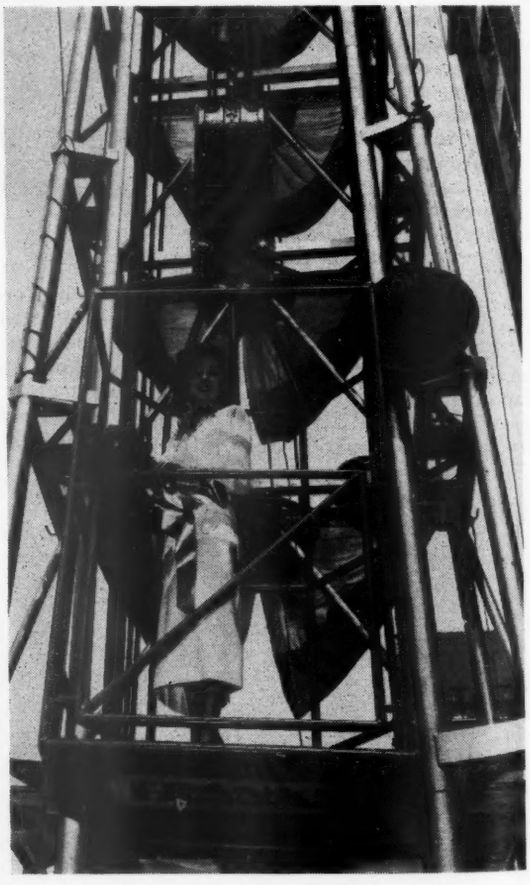
The Sinclair Oil and Gas Company has been formed as a result of the merger of the Sinclair Prarie Oil Company, Sinclair Wyoming Oil Company, and the Repollo Oil Company. Headquarters for the three companies are in Tulsa, Oklahoma, with W. L. Connelly, Tulsa, chairman of the boards, and Henry L. Phillips, New York, formerly of Tulsa, as president.

Saudi Arabian Production

Crude oil production in Saudi Arabia during April amounted to 15,706,652 bbl, or an average of 523,555 bbl per calendar day, compared to 489,820 bbl a day in March. Crude processed at the company's refinery at Ras Tanura amounted to 4,243,226 bbl, or an average of 141,441 bbl per calendar day. In March the average was 127,282 bbl per calendar day.

World premiere of the movie "Tulsa" drew more than 100,000 people to the streets to watch opening day parade in Tulsa, Oklahoma. City schools and business houses closed for the display of more than $10,000,000 worth of actual oil well equipment in the parade.

Susan Hayward, star of "Tulsa," holding elaborate bouquet of roses, poses for camerman atop flag-drapped derrick. Governor R. J. Turner acted as official host to Miss Hayward, and other stars, Robert Preston and Chill Wills.



One of the floats in the gigantic "Tulsa Day" parade shows detailed intricacies of refining processes. Oil equipment was left in a roped-off section in the main business district for display during the premiere celebration.

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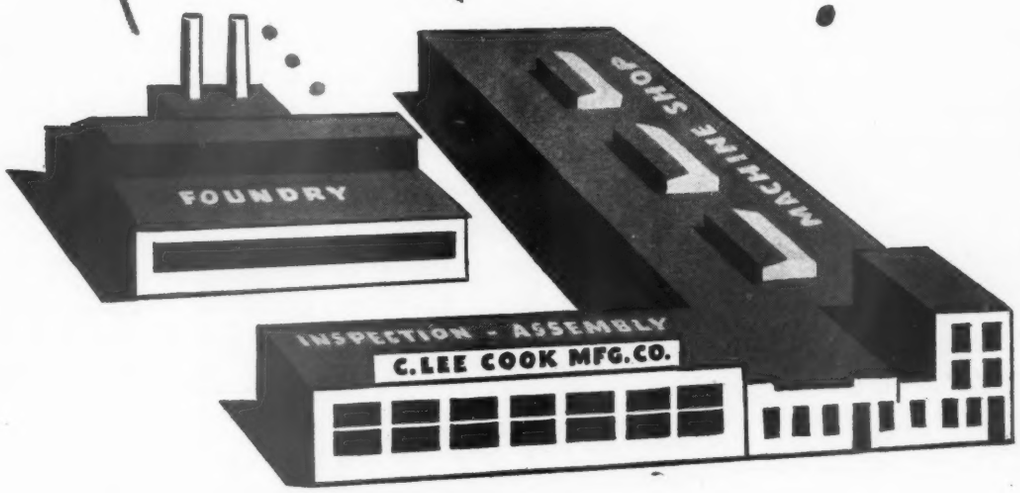
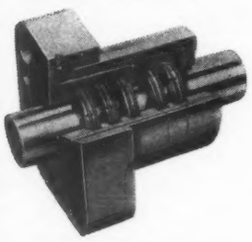


***"Speed Our Shipment"** is a distress signal we often get from operators faced with unscheduled shutdowns or with prospective overhaul jobs.

Cook Piston Rings



Cook Metallic Rings

And speed the shipment we do. Our close association with the needs and requirements of compressor and engine operators in every branch of industry gives us an appreciation of the importance of sure, dependable delivery of packings and piston rings at the right time.

How do we do it? Simple enough—we carry standard types of packings and piston rings in stock at strategically located warehouses. For those applications which can't thus be supplied, we have a streamlined production setup which insures fast handling of your order right on through from our own foundry to shipping department.

So, when you need packings and rings in a hurry call on Cook. Your "S.O.S." will bring a "P.D.Q." delivery.

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Oil Demand Increases

According to a report of the supply and demand committee of the Independent Petroleum Association of America, total petroleum demand in 1949 will average 6,370,000 bbl a day, 4 per cent over the 6,129,000-bbl daily average consumption of 1948. The prediction was made in the committee's regular quarterly forecast.

The increase over 1948, however, is less than the 8 per cent predicted by the committee in its December forecast, and the 6 per cent gain previously estimated by the Interstate Oil Compact Commission economics advisory committee. The slowing down in demand is attributed to "abnormally warm weather which reduced requirements for heating fuels; a change in general business conditions reflected in a decrease in industrial activity; a decrease in wholesale price levels and increasing unemployment, and large increases in foreign oil supplies available for consumption in the world market."

According to the committee, total stocks of crude petroleum and refined products increased 106,500,000 bbl during 1948 and on March 31 of this year were more than 120,000,000 bbl over the like date in 1948 and 51,000,000 bbl over December 31, 1948.

Oil Deficit in War

The Railroad Commission has been advised by Secretary of Defense, Louis Johnson, that the nation, in event of a major war, will be dependent on large amounts of foreign oil.

The Defense Secretary said in a letter to United States Senator Lyndon B. Johnson of Texas that the current petroleum picture for the Western Hemisphere is relatively sound. He added, however, that if a major five year's war were to start today, total Western Hemisphere production must be expanded by 15 per cent by the end of the 5-year period."

The United States, Johnson said, would be in a relatively sound position from a petroleum standpoint provided the expansion is accomplished and provided all the wartime production potential of the hemisphere can be channeled into a joint war effort.

The letter, read, "Our national security in time of a major war, from the petroleum standpoint, is still dependent upon availability of large amounts of foreign oil."

Anniversary Plans Made

The Pennsylvania Grade Crude Oil Association will help sponsor on August 27 an oil region celebration of the 90th anniversary of the Drake discovery oil well drilled at Titusville, Pennsylvania. The association's board of directors' meeting at the Arlington hotel in Oil City, Pennsylvania endorsed the observance. Col. E. L. Drake's well was the first drilled for oil.

D. T. Ring of Columbus, Ohio, association president, surveyed the country's current oil situation at the board of directors' meeting.

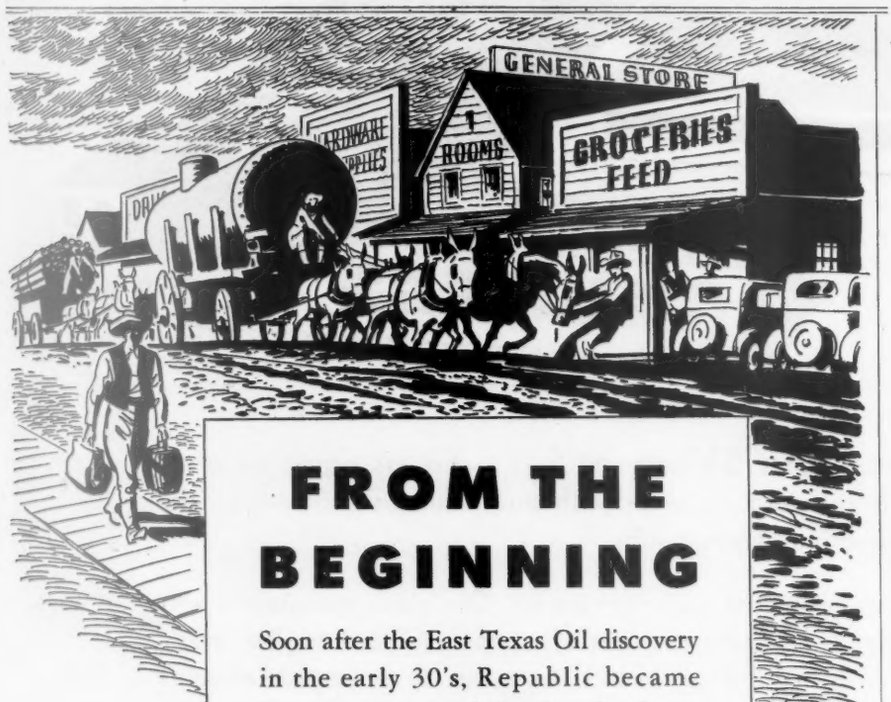
Reserve Units Activated

Six additional army organized reserve units were activated as part of Sun Oil Company's army affiliation program. Sun-sponsored army units now total 10, including a unit activated at the company's Toledo, Ohio, refinery May 18.

Addressing reservists at an activation ceremony Robert G. Dunlop, president of Sun, stressed the important role that the petroleum industry plays in defense planning.

Safety Record Maintained

Continental Oil Company's entire organization has maintained an unbroken period during most of March and April when 2,301,246 employe hours were recorded without lost time from injury. The safety mark was established with 8558 employes on the company's payrolls. Continental's refinery at Ponca City, Oklahoma, recorded a 98-day period with no lost time due to injury.



FROM THE BEGINNING

Soon after the East Texas Oil discovery in the early 30's, Republic became known as one of the few banks to which oil producers could turn for funds in development of oil properties.

The scope has widened over the years until today there are few major producing areas in which this bank has not had a part in providing this essential type of credit.

This is one of the many reasons why Oil Men look to Republic when they need financial assistance.

CAPITAL AND SURPLUS — $25,000,000 . . . LARGEST IN THE SOUTH

REPUBLIC NATIONAL BANK of DALLAS

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CHRYSLER INDUSTRIAL ENGINES now available with...

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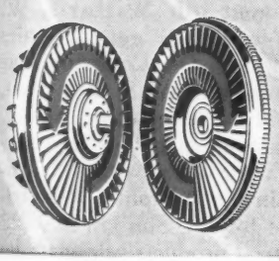
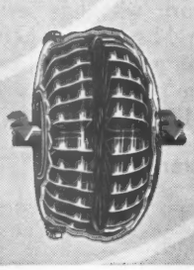
Fluid Drive

at Amazingly Little Cost!

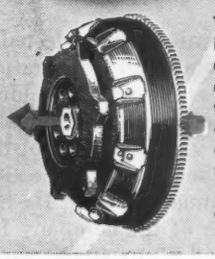
Actually only slightly more than the conventional flywheel which it replaces.



Driver and Runner flywheels are shaped like shallow bowls fitted inside with fins. They operate as separate units, with no mechanical connection—no metal-to-metal contact.



As the Driver turns inside the sealed steel drum, the confined oil produces a powerful swirling out-thrust. Instantly, the Runner receives the impulsion and transmits smooth power to the load.



The coupling is an integral unit. No adjustments are necessary. Oil maintains required fluidity over a wide temperature range. Remains unaffected by seasonal temperature changes.

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PROVED on thousands of industrial jobs—scores of applications under rugged field conditions.

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CHRYSLER

Industrial Engines and Power Units

HORSEPOWER WITH A PEDIGREE

PERSONALS

H. T. Earl, H. B. Haney, R. K. Kelly, G. R. Kinter and J. E. Roth have been appointed vice presidents of Tide Water Associated Oil Company, according to an announcement made by William F. Humphrey, president.

Earl is in charge of purchases and exchanges of crude oil and products required to supplement the production of the company's western division. He has been continuously employed by the company and its former subsidiary, Associated Oil Company, for more than 45 years.

Haney, 32 years with the company, is in charge of all marine, pipeline, traffic and automotive activities of that division.

Kelly, a graduate of the U. S. Naval Academy at Annapolis, served for 12 years in the construction corps of the Navy and in 1936 resigned from the Navy to join Tide Water Associated Oil Company. Soon thereafter he became manager of marine operations of the company's eastern division. He served as assistant director of transportation for the Petroleum Administrator for War.

A resident of Tulsa, Oklahoma, Kinter entered the company's employ as a refinery chemist in 1921 and has been vice president of the company's subsidiary, Tidal Pipe Line Company, since 1934.

Roth, who also resides in Tulsa, Oklahoma, was first employed by the company in 1924, and is now production manager of the Mid-Continent division.

Alden S. Donnelly was elected a director of Honolulu Oil Corporation at the annual meeting of stockholders of the corporation recently. Donnelly was also elected vice president of the corporation at the directors' meeting following the annual meeting. He has been an employe of the company for over 18 years, and is now in charge of the company's operations in the Mid-Continent area, with offices at Midland, Texas.

Arthur A. Curtice has been elected president of a Conorada Petroleum Corporation, recently organized by Continental Oil Company, The Ohio Oil Company, and The Amerada Petroleum Corporation. This organization has been formed for the purpose of joining efforts to investigate prospects for the development of oil producing properties abroad. Curtice will be in direct charge of its operations with offices in New York City.

W. H. Egolf, Barber Oil Corporation, has been elected treasurer to succeed E. R. Riter, retired.

C. A. Thomas, secretary of Barber, was elected vice president and secretary.

Lawrence R. Sperberg has been appointed manager of market research evaluation in the Philblack sales division of Phillips Chemical Company, a subsidiary of Phillips Petroleum Company.

Sperberg, who has been manager of the research evalution and testing sections of the chemical division in Phillips research department, will be in Bartlesville, Oklahoma. He attended Hillsdale College and the University of Michigan, joining the research department of Phillips in 1940.

Chester M. Crebbs, president of the Mene Grande Oil Company in Caracas, Venezuela, retired May 1, after 31 years of service with the Gulf Companies. Crebbs joined Gulf Production Company at Fort Worth, Texas in 1918. After one year in France during the first World War, he returned to the Gulf Corporation as geologist, and in October of the next year he was transferred to Mexico where he subsequently became chief geologist of the Mexican Gulf Oil Company at Tampico. Crebbs first went to Venezuela in 1923, as general agent for the Venezuela Gulf Oil Company. Following acquisition by the Venezuela Gulf Oil Company of Mene Grande Oil Company in 1936, he was elected president of Mene Grande, a position he held until his recent retirement.

He is succeeded as president by **Hoyt Sherman,** who has served as assistant to Crebbs in various capacities since 1928, and who has held the position of vice president of the company since 1947.

Chester M. Crebbs

R. L. Baxter

R. L. Baxter, president of Arkansas Western Gas Company, was elected president of the Southern Gas Association at the 41st annual meeting in Biloxi, Mississippi. Prior to 1945, Baxter served six years as secretary of S.G.A. and was elected vice president of this association last year.

Baxter became associated with the natural gas business in 1932 when he was employed as district manager of Arkansas Western Gas Company, whose properties are in northwest Arkansas. He was elected vice president of this company in 1936, becoming president in 1943.

A member of the board of directors of Arkansas Economic Council and Arkansas Industrial Association, he is also a member of the American Gas Association. He was recently appointed to the board of trustees of the Southwest Research Institute.

Appointment of **Willard W. Wright** as assistant general sales manager of Sun Oil Company was announced recently by S. B. Eckert, vice president in charge of marketing. Former regional manager for New England, Wright will move to the general office in Philadelphia, Pennsylvania. Since joining Sun Oil in 1922 as an industrial products salesman, he has served as managing director of Sun Oil Company, Ltd., Montreal, Canada, and assistant regional manager of the Western Region at Detroit, Michigan.

Richard D. Drysdale succeeds Wright as New England regional manager. Drysdale has been with the company since 1927, when he began as a stenographer in the credit department.

John C. Weidman has been appointed assistant regional manager of the Middle Atlantic Region to succeed Drysdale. A graduate of Grove City College, Massillon, Ohio, Weidman joined Sun Oil Company in 1930.

PERSONALS

▸ **G. F. Moore** has been named division gas superintendent for Stanolind Oil and Gas Company at Casper, Wyoming. Moore is a graduate of the University of Delaware.

In the newly created post, he will be responsible for the technical phase of the operation of Stanolind's natural gasoline, cycling and pressure maintenance plants in the division, which include the Elk Basin Gasoline Plant at Elk Basin and the Salt Creek Gasoline Plant at Midwest, Wyoming.

▸ **Robert H. Ausfahl** of Standard Oil Company of California has received one of the 10 highly coveted Sloan Fellowships to study for a year at the Massachusetts Institute of Technology. A senior analyst in Standard's department on organization, Ausfahl will study management, economic, and social problems of industrial administration. He was chosen in a nationwide competition.

The fellowships, intended to broaden the experience of young executives with several years of business training, are sponsored by the Alfred P. Sloan Foundation, Inc. Begun in 1931, they are being resumed after the interruption caused by the war.

▸ **William J. Nash** has been appointed to the public relations section of Stanolind Oil and Gas Company, succeeding J. W. Bartram who is resigning to become assistant to the president of the University of Colorado at Boulder, Colorado.

Nash was formerly associated with the Monsanto Chemical Company and Bemis Bag Company of St. Louis, Missouri, in the public relations divisions of these companies.

He attended Stanford and Montana State universities, Montana State College, and University of Missouri.

▸ **Lafayette D. Lytle,** vice president of the Coastal Petroleum Company, and director of publicity of the Coastal Oil Company, Newark, New Jersey, passed away at the Muhlenberg Hospital, Plainfield, New Jersey. Lytle had been with the Barber Asphalt Company for 35 years before joining the Coastal Oil Company in 1943.

During the last war, he served as consultant to the Army Ordnance Department and was a member of many industry committees. In World War I he served in France and Italy as First Lieutenant in the 332nd Infantry. He was a member of the personal staff assigned to President Wilson when he visited Italy following the war.

▸ **G. L. Stewart** has been elected president and H. H. Hewetson chairman of the board of directors of Imperial Oil Ltd. Hewetson asked not to be nominated for re-election to the presidency in order that he might be relieved from the duties of chief executive and give more time to broader activities in the company's interests.

Stewart is a graduate of McGill University in Montreal, Canada, as a bachelor of science in mechanical engineering. For a while it seemed as though he were destined for a teaching career, for after graduation he stayed with the university for nearly two years as a lecturer and demonstrator. His career in the oil business began in 1916 when he joined the engineering department of Imperial at Sarnia. After two years there he was transferred to Halifax as mechanical superintendent. He was later transferred to the manufacturing department head office in Toronto, and three years later he went to Regina as assistant superintendent. Stewart was made superintendent of Sarnia refinery in 1931, and in 1934 was appointed general manager, Toronto office, in charge of all refineries. He later became a vice president and director of Imperial, in charge of the company's manufacturing operations and was elected chairman of the board in 1947.

O. B. Hopkins, J. R. White, F. G. Hall and **K. A. Henderson** were re-elected vice presidents and Henderson was also reappointed as treasurer. **James McGrath** and **Colin D. Crichton** were reappointed as comptroller and general secretary, respectively. **J. A. New** and **J. W. Hamilton** are general counsel.

▸ **Floyd B. Odlum,** president of the Atlas Corporation, New York, which owns a substantial block of stock of Barnsdall Oil Company, was elected chairman of the board of Barnsdall. Odlum succeeds William Dewey Loucks who was elected president of Barnsdall, replacing James A. Dunn, retired.

▸ **James K. Ellis,** vice president in charge of production, and a director of Sunray Oil Corporation, has resigned to accept a position with the Slick-Urschel interests of San Antonio, Texas.

Ellis was vice president in charge of production for Transwestern Oil Company, which the Slick interests controlled, when Transwestern was merged into Sunray nearly three years ago. Upon completion of the merger, Ellis was placed in charge of production for Sunray and made a vice president and director.

GEORGE L. STEWART
Imperial Oil President

▸ **William B. Mather,** economic geologist, has been appointed to the staff of Southwest Research Institute in Houston and San Antonio, Texas, as chairman of mineral technology. Dr. Harold Vagtborg, president, announced the appointment, effective June 1.

He received his education at McMaster University in Ontario, Canada and the University of Chicago, Illinois. Mather, who resigned from Midwest Research Institute's staff at Kansas City, Missouri, to come to San Antonio, was an aeronautical engineer with the Royal Canadian Air Forces during the war.

At Southwest Research Institute, Mather will be in charge of ceramics, metallurgy, mineralogy, and geology. His special fields also include petrology, chemical microscopy, mineralography, petrography, and geochemistry.

▸ **Ralph P. Bolton,** of the producing coordination department of Standard Oil Company (New Jersey), was appointed its representative for affiliates engaged in producing, refining, and marketing operations in Italy.

Bolton has headed the company's producing activities in the Eastern Hemisphere since 1944, having joined the company 27 years ago as a general field assistant for an affiliate in Roumania.

LAUGH WITH BARNEY

A businessman fell in love with a night club entertainer. To be safe he employed a detective agency to check up on her habits. He received the following report:

"The young lady has an excellent reputation. Her past is without a blemish. She has many friends of high social standing. The scandal associated with her is that she has been seen on numerous occasions of late in company with a businessman of questionable character."

* * *

Mama (with concern): Paul brought you home rather late last night, didn't he?

Daughter: Did the noise disturb you, Mama?

Mama: No, it was the silence.

* * *

An undertaker found a donkey lying dead on his front lawn and went to inform the police. "What am I to do with it?" he asked the officer in charge.

The officer had a sense of humor. "Do with it?" he asked, "Bury it, of course. You're an undertaker, aren't you?"

"That's true," replied the undertaker with equal humor, "but I thought it only right to come around and inform the relatives first."

A gentleman, on being informed that he was a proud father of triplets, was so overjoyed at the news that he rushed immediately to the hospital, where his wife and newly-acquired family were and dashed pell-mell into the room.

The nurse, being out at the time, was irritated upon her return and remonstrated with the father.

"Don't you know better than to come in here in germ-filled clothes? Why you're not sterile."

"Lady, are you telling me?"

* * *

Father: You take accounting at school, don't you?

Son: Why, yes dad.

Father: Well, maybe you can account for the brassiere and panties you sent home in your laundry last week?

* * *

A romantic pair were in the throes of silence as the car rolled smoothly along an enchanting woodland path, when the lady broke the spell:

"John, dear," she asked softly, "can you drive with one hand?"

"Yes, my sweet," he cooed in ecstasy of anticipation.

"Then," said the lovely one, "you'd better wipe your nose, it's running."

Two gamblers were convalescing in a hospital endowed by a very strict religious denomination known for its opposition to gambling in any form. Thinking they had better keep in practice during their illness, they repeatedly asked for playing cards and were refused. Finally they asked the superintendent if they might have 52 "case report cards." This request was granted and the gamblers set about devising their own game of poker, instead of going by suits and numbers, betting on the information on the cards to determine their value.

After dealing, drawing and betting, one of the gamblers said, "I'll check, what have you got?" "Two pair—a pair of adenoids and a pair of tonsils. What are you holding?"

"Four enemas," replied the first gambler.

"You win, take the pot."

* * *

Tony (talking on phone to garageman): I want you to come feex my car. . . . She no go.

Garageman: What seems to be the trouble?

Tony: I dunno . . . but the battery, she no bat. The spark plugs, da no spark. The generator, she no gin. The pistons . . . they no work either.

* * *

Johnny was not at the dinner table when his father came home, for his mother had sent him upstairs to bed for swearing.

"Swearing?" bellowed the father. "I'll teach him to swear!" He dashed up the stairs and midway, stubbed his toe, stumbled and crashed his chin on the step. When the atmosphere cleared a little, Johnny's mother said sweetly:

"No more now, dear. You've given him enough for one lesson."

* * *

A newlywed wired his boss: "Please extend my vacation. It's wonderful here." To which the boss replied: "Come back at once; it's wonderful any place."

* * *

The salesman was trying to "pick up" a beautiful blonde in the hotel lobby. She said: "Don't bother me." He said: "Pardon me, I thought you were my mother." She said, "I couldn't be, I'm married."

* * *

Jones, a good family man, had been inveigled into a poker game, and experienced growing apprehension as the hand of the clock moved relentlessly on toward morning. Finally, at 3 a.m., he had a sudden inspiration. He called his home, and when his wife answered the phone, he shouted, "Don't pay the ransom; I'm back!"

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We can give you the best bearing service per dollar invested.

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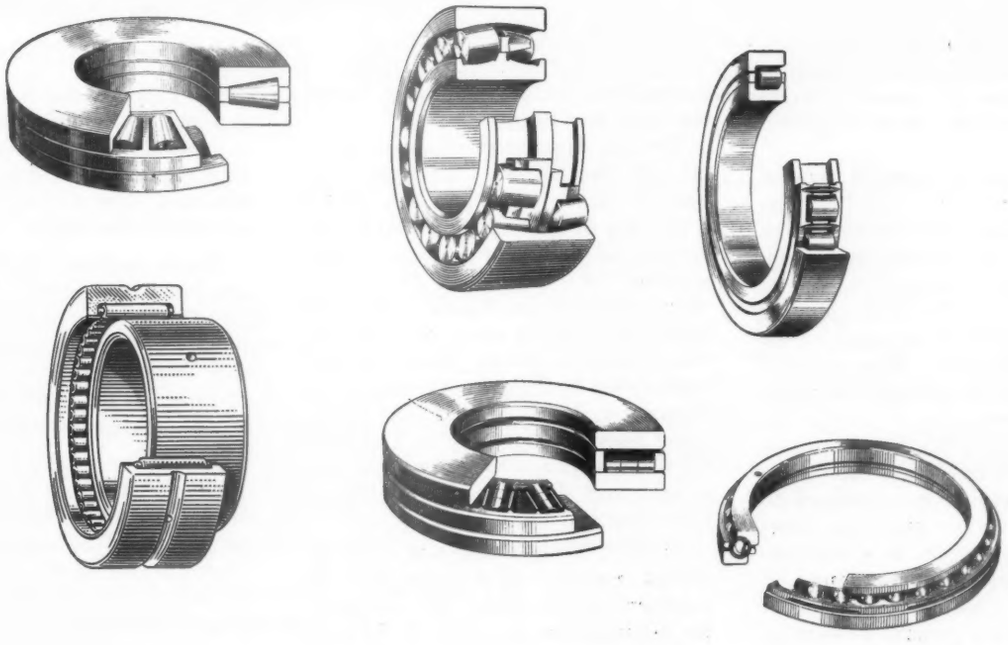


BEARINGS

STRAIGHT ROLLER • BALL • NEEDLE ROLLERS

Petroleum Profile

O. F. MOORE

Vice President

The Ohio Oil Company

WHEN O. F. "Mike" Moore first hung up his hat in The Ohio Oil Company's Robinson, Illinois, field office in 1909, he quickly demonstrated himself to be a young man with the diligence and ability to turn in a top-notch performance on any assignment given to him. Friendly, with an even-tempered personality, Mike was not many years removed from his boyhood on an Indiana farm and his studies at Brown's Business College in Terre Haute.

Two years later he was sent to Marshall, Illinois, as clerk to the superintendent of the gathering lines. There he learned, among other things, that diligence in pipelining is not always confined between the hours of eight and five, and he has never forgotten it since.

Brought to the company's general office in Findlay, Ohio, in 1912, he absorbed experience for the next three years in the stock transfer, leasehold, and right-of-way departments, and as secretary to O. D. Donnell who was then assistant general manager of the company. Incidentally, Mike can still jot down a hasty shorthand note when pressed for time.

On January 1, 1915, he was transferred to The Illinois Pipe Line Company, which had been organized to take over the Ohio's pipe line functions and expand them as a common carrier. The new company found itself in need of a soft-spoken, friendly sort of man with a general knowledge of pipe line problems and procedures, and a considerable knowledge of human nature, for the exacting job of conferring with various state, county, and local boards on advalorem tax matters. These qualifications were a remarkably accurate description of Moore, and he entered on this new phase of his career with characteristic enthusiasm and diligence. He performed well and learned much during the next few years.

He was appointed assistant secretary of The Illinois Pipe Line Company in April, 1915, and was elected a director in September, 1917. In December of that year he was elected secretary of the company. He became vice president in April, 1938, and held that position until the company was dissolved and its functions were reabsorbed by the parent company on January 1, 1943. At that time he became assistant secretary of The Ohio Oil Company, and vice president, secretary, and director of The Illinois Pipe Line Company of Texas.

In May, 1944, Moore was made assistant manager of the pipe line department of the Ohio Oil Company. He became vice president of the company and manager of the pipe line department on February 1, 1946. Later that year, he was elected to the board of directors.

Today, he is still "Mike" to nearly everyone. His human qualities and his genuine interest in his fellow employes are quickly sensed by the newest field office clerk or member of a pipe line gang.

His capacity for hard work is still apparent in the long hours he devotes to careful management of the lines. He meets every problem with a calm efficiency that makes even a difficult solution seem easy.

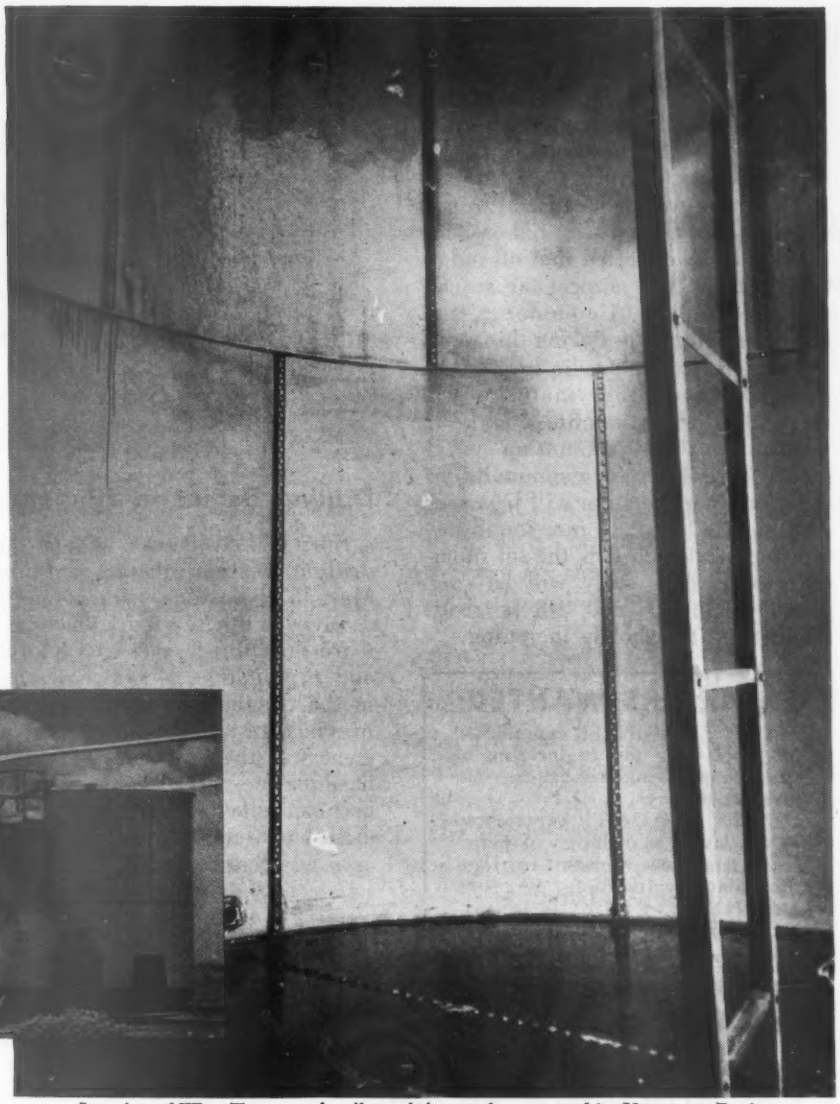
Not an engineer, he leaves the more obscure technicalities of that profession to those trained for it. But he is constantly alert to technical progress, and his engineers never cease to be surprised at the penetrating questions he can ask about various aspects of their work.

Mike's industry activities outside the company presently include service on the board of councillors and the Central Committee on Pipe Line Transportation of the American Petroleum Institute.

With a deep sense of civic responsibility, he finds time in a crowded schedule to serve as president of the Findlay Hospital Association. He is president of the Findlay Auto Club, a member of the Chamber of Commerce and the Elks Lodge, and a trustee of the Findlay Country Club where he occasionally manages a round or two of better than average golf.

Life Insurance—without "Premiums"

Data courtesy Minnesota Mining & Mfg. Co.



Interior of West Texas crude oil receiving tank protected by VINYLITE Resin-based coating for 3 years. Streaks at upper left are free-flowing petroleum.

● These sour crude receiving tanks—like hundreds of others in West Texas—are now protected against acid attack and corrosion by a life-insuring coating based on VINYLITE Brand Resins *that effect a tremendous saving in refinishing costs—at low first cost!*

For tank coatings based on VINYLITE Brand Resins are highly resistant to acids, alkalies, and other strong chemicals, and the corrosive action of sour crudes and salt water. They are resistant to thermal shock as well. And their coating film remains *intact* despite long service—maintaining its integrity and bond. Costly metal corrosion is averted.

VINYLITE Brand Resin coatings are protecting receiving tanks, storage tanks, pipes, and equipment throughout the petroleum and processing industries. They are even being used in off-shore petroleum installations—under water as well as above—and in tankers' cargo tanks. They not only protect containers from contents, but contents from contamination by the container materials. For more detailed technical data and information on suppliers of coatings based on VINYLITE Brand Resins, write Department GI-57.

Vinylite BRAND **RESINS**

BAKELITE CORPORATION

BAKELITE CORPORATION, *Unit of Union Carbide and Carbon Corporation* UCC 30 East 42nd Street, New York 17, N. Y.

Progress Week Set

Oil Progress Week will be held throughout the nation on October 16-22. Because of the enthusiasm in 1948. Oil Progress Day has been expanded to a week this year.

This event will be localized through OIIC district committees and association, and it is expected that oil industry speakers will appear at service clubs, chambers of commerce, and other similar groups during this week.

Booklets, leaflets, radio broadcasts, speeches, and other material will reach the local committees early in September. A manual pointing out the many possibilities for community activity and participation will be issued shortly. A 20 min, 16 mm sound motion picture which tells the oil industry's progressive story will be completed on July 1, and will be ready for distribution shortly thereafter.

ENGINEERS WANTED:

PROJECT ENGINEER experienced in correlating the engineering of gasoline plants and natural gas compressor stations.

DESIGN ENGINEER experienced in the layout and design of petroleum refineries. Kansas City location. State qualifications. Box 100, c/o THE PETROLEUM ENGINEER, Box 1589, Dallas, Texas.

Drilling Begins in Ethiopia With Proper Ceremony

Sinclair Petroleum Company began drilling the first oil well in Ethiopia May 17, according to cable advices received at the New York offices. After more than three years of exploration and exploitation, a site was selected in the Gumburo Hills district of the province of Ogaden. Drilling equipment was then moved in from base headquarters at Dire Dwa, and rig and campsite facilities erected. Wells drilled to water bearing sands in the area adjacent to the well-site provide satisfactory drinking water as well as water for drilling operations.

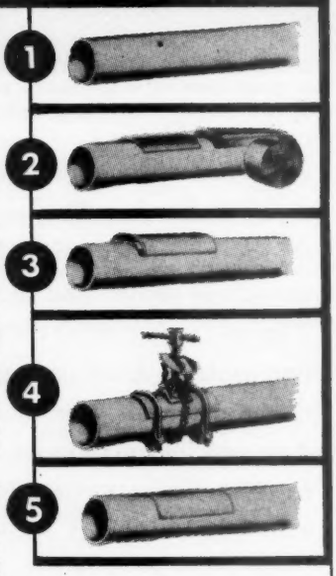
More than 3000 long tons of material and equipment necessary for the operation have been shipped to Ethiopia from the United States.

Emperor Haile Selassie accompanied by his son Duke of Harrar, Yilma Deressa, vice minister of finances, Ras Abebe, minister of war, and high officials from his imperial civilian and military suite flew down to the drilling site for the occasion. Selassie was presented a golden commemorative medallion by Sinclair, and similiar bronze ones were persented to guests as tokens of appreciation of cooperation from the emperor and government officials.

REPAIR PIPE LINE LEAKS

SIMPLY and QUICKLY

1. Whatever size leak may be, simply cut necessary length of GRO-CORD gasket to cover generously.
2. Cut a piece of plate, or any ready-made half-sole or sleeve, to extend about 1" on both sides and both ends of the gasket.
3. Fit plate over the gasket so it extends beyond the GRO-CORD pipe repair gasket on all sides.
4. Clamp repair tight with a chain jack to shut off the leak. Use clamps to hold plate or half sole in contact with the pipe at all points. Weld all around and REMOVE CLAMPS. If desired, chain jack may be left indefinitely until welding equipment is available. Gro-Cord gaskets have been in service as long as 5 years before final weld.
5. Permanent welded repair after chain jack removed.



Specially shaped Gro-Cord pipe repair gaskets are used by pipe line companies everywhere. Actually tested at 1600 p.s.i., Gro-Cord will not deteriorate. Oil resistant cotton impregnated stock lasts for years. May be used with welded or clamped repairs. Write for folder OGJ 49.

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The Petroleum Engineer

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Drilling Mud Programs

GREAT strides have been made during the past 20 years in the design and control of drilling mud programs that enable drillers to reach greater depths with more safety, with less damage to intermediate producing formations, and with less need for the setting of intermediate strings of casing. The properties of drilling mud can usually be controlled now by the addition of various materials and treatment with chemicals so as to prevent lost circulation, caving of the hole, salt water flows, gas blowouts, stuck drill pipe, or other serious difficulties that might be encountered in drilling through long stretches of open hole.

A drilling mud program that suits one area may not, however, suit another area. Drilling mud heavy enough to prevent gas blowouts in one area might cause lost circulation in another. Each area and even each well often presents its own peculiar problems. Drilling mud programs are usually based, therefore, on previous drilling experience in an area. The nature of the formations to be penetrated, the fluids they contain, the pressures to be balanced by the drilling mud column, the drilling time, and the properties of the drilling mud are important factors to be learned in the drilling of exploratory wells. The importance of formulating drilling mud programs for development wells is underscored by the fact that drilling mud materials and chemicals for deep wells may cost as much as 50 per cent of the total cost of the early wells drilled in an area. More than $150,000 has been spent for drilling mud on a 10,000-ft well in the Gulf Coast, and a $50,000 mud bill is not uncommon on 10,000-ft wells in many areas. Such high costs on deep exploratory wells can sometimes be avoided through continuous checking of the drilling mud properties and prompt treatment to maintain the desired weight, gel strength, viscosity, filter cake thickness, and other characteristics, but it is usually impossible to effect important economies without increasing the risk of blowouts, stuck pipe, or other accidents until sufficient experience has been gained in an area or field.

Water and natural clays are still the most widely used constituents of drilling muds. Water is used alone in drilling through certain hard formations in West Texas and other areas, but, when the drill begins to penetrate salt, porous sandstones or limestones, heaving shale, or other formations that cave, cause lost circulation, or threaten to blowout, the operator is confronted with the necessity of planning a drilling mud program. Operators would be unable to drill and complete today's deep, high pressure wells in most areas without the benefits of modern drilling mud technology and the great variety of specialized materials and chemicals that are available for use in the drilling mud system. Mud materials, chemicals, and continuous improvements in drilling mud practice serve to protect the hole, the drilling equipment, the personnel, and the large investments that are involved in exploring and developing petroleum reserves.

K Marshall Fagin

When Well Conditions Demand A

NOT only does the Baker Model "D" Retainer Production Packer take care of the "every day," simple installations, but it is adaptable to many of those previously difficult or impossible applications.

This is due first to the construction of the Packer itself, employing two sets of opposing slips, with a Hycar packing element between them, so that the Packer virtually becomes a part of the casing, cannot be moved up or down the casing, and prevents fluid or gas from passing between the packing element and the casing. When the Setting Tool, used to set the Packer, is removed from the well, only the smooth-bore Packer is left in the well, securely packed-off, and ready for selection and use of the proper Baker Packer Accessory Equipment to meet production requirements.

ACCESSORY EQUIPMENT IMPORTANT

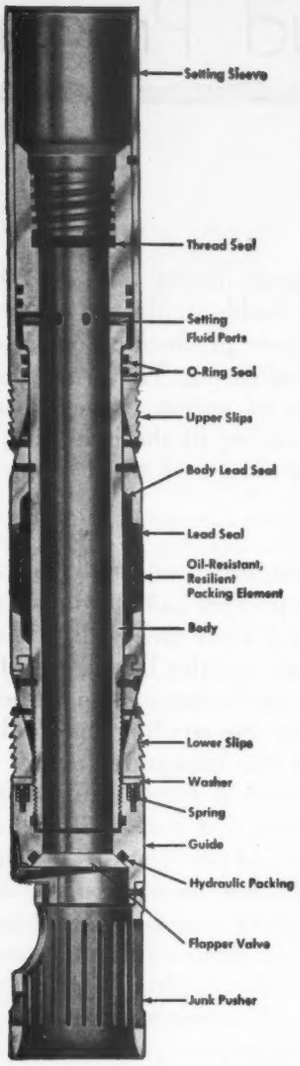
It is the complete line of Accessory Equipment that is responsible for the outstanding adaptability of Baker Packer installations to produce one or more zones, simultaneously or separately—through tubing or casing—and often with flexibility to permit production changes without pulling the tubing string.

One interesting and useful accessory unit is the Baker Tubing Seal Nipple, Multi-V Type (Product No. 448-D) which is an important element in many Packer installations to effect a fluid-tight seal in the annulus between the tubing string and the internal smooth bore of the Packer. This unit permits movement of the tubing string, either up or down, over the length of the Packer bore; and, for additional movement more than one Multi-V Tubing Seal Nipple may be used, as shown in Figure 1 on the opposite page.

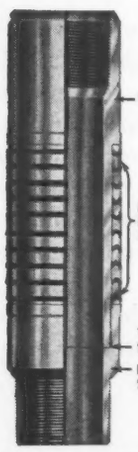
CONVENIENT LATCHING SUB

The Baker No Left Turn Latching Sub (Product No. 473) is positioned in the tubing string just above the Tubing Seal Nipple. This ingenious device does not effect a seal, but provides a quick-engaging, positive hold-down for the tubing production string, and holds the Tubing Seal Nipple in proper position in bore of Packer where it cannot be moved upward or downward by expansion or contraction of the tubing string.

Inasmuch as no "set-down" weight is required for operation of this Sub, the tubing can be suspended in tension, if desired, so that pressure bombs (and other devices) may be dropped readily through the tubing. Operations are not handicapped by "corkscrewed" tubing which often results when set-down weight is applied to conventional type packers.



Baker Model "D" Retainer Production Packer Product No. 415-D



BAKER TUBING SEAL NIPPLE, MULTI-V TYPE, which effects a fluid-tight seal between the tubing string and the bore of the Packer.

APPLICATIONS ARE MANY AND VARIED

In addition to the fact that the Baker Model "D" Retainer Production Packer is used for single-zone or multiple-zone production applications, it is ideal for isolating casing, for salt water disposal, for acidizing, re-pressuring, and many other applications.

Other features which appeal to veteran production men are its Complete Drillability—Resistance to High Temperatures—Corrosion-Resistant Construction—Freedom of the Tubing from the Packer—and Positive Anchoring Against Upward or Downward Movement.

Descriptions, illustrations and specifications are in your 1948 Baker (or Composite) Catalog; a new brochure covering the Baker Retainer Production Packer will soon be off the press ready to mail at your request; and Baker representatives in every active area are anxious to serve you.

BAKER OIL TOOLS, INC.
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Demand a BAKER Model "D" R

A PRODUCTION PACKER

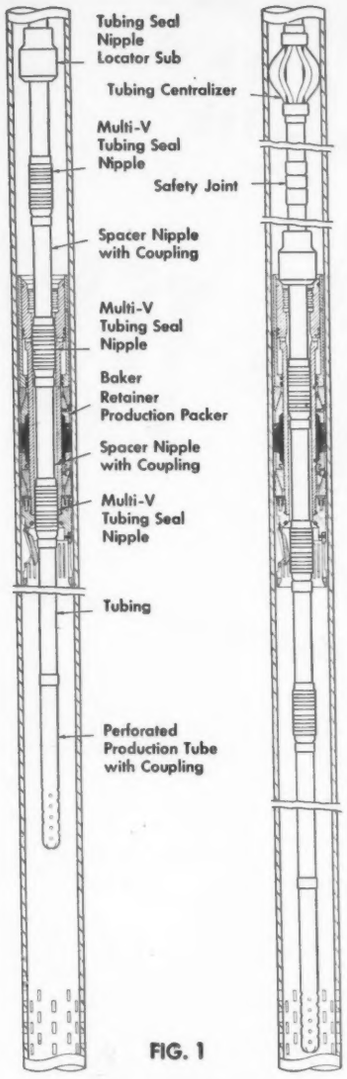


FIG. 1

FIGURE 1—(left)

This single-zone installation is recommended where it is necessary to compensate for variations in the length of the tubing string, and to prevent excessive weight being imposed upon top of Packer when extreme increases in bottom hole temperatures cause expansion of tubing.

Three Baker Tubing Seal Nipples, Multi-V Type, are used, and spaced so that one Nipple is always sealed off in the bore of the Packer. The desired length of the tubing string is determined, to permit proper spacing of the Multi-V Nipples in the Packer and allow for proper connection at the tubing head. The tubing string is run into the well until the Baker Locator Sub contacts the top of the Retainer Production Packer. The tubing is then raised to remove the Seals from the Packer, to permit circulating and unloading the mud from the well. When the well has been unloaded, the tubing is set down and the final Christmas tree connections made.

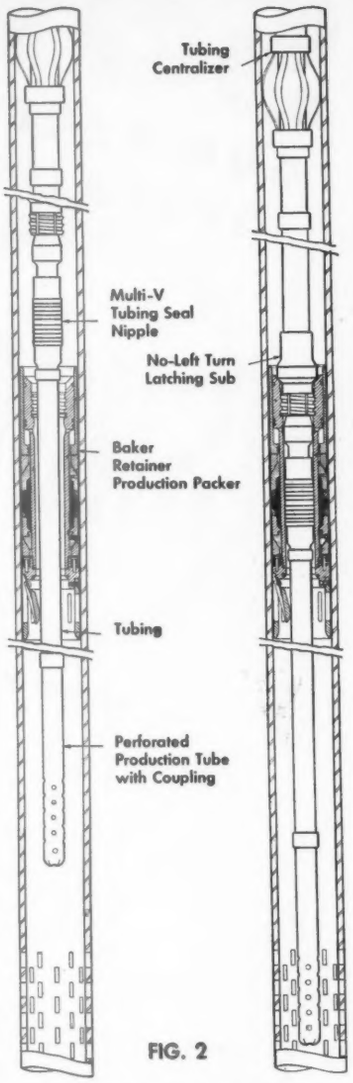


FIG. 2

FIGURE 2—(center)

This hook-up is for producing a single zone with the production string anchored to the Packer, an advantageous feature when it is desired to: (a) produce the zone by pumping, while keeping the production string in tension; or (b) produce the zone by flowing without having to impose excessive weight on the Packer in order to hold the Tubing Seal Nipple properly positioned in the Packer bore; or (c) high pressure injection of gas or fluid for re-pressuring or secondary recovery.

The production string is run in the casing until the No Left Turn Latching Sub rests on top of the Packer. This is indicated at the surface by a drop in weight recorded on the strain indicator or the weight indicator. The production string is then raised approximately five feet, and in this position the zone may be washed and brought in, if it will flow.

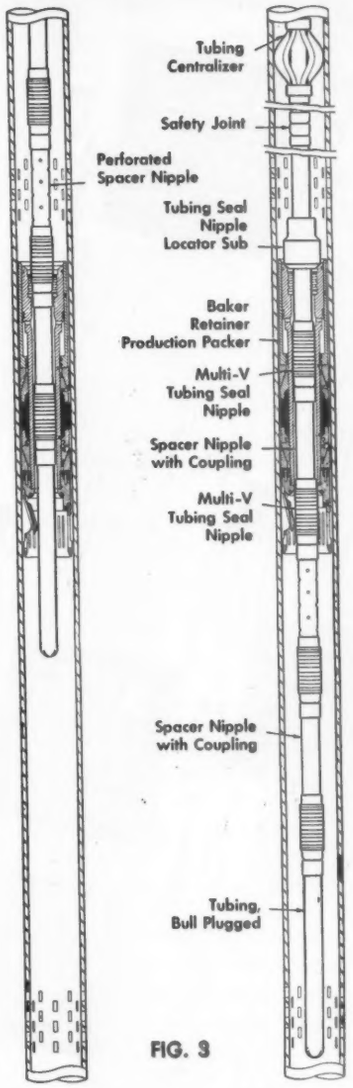


FIG. 3

FIGURE 3—(right)

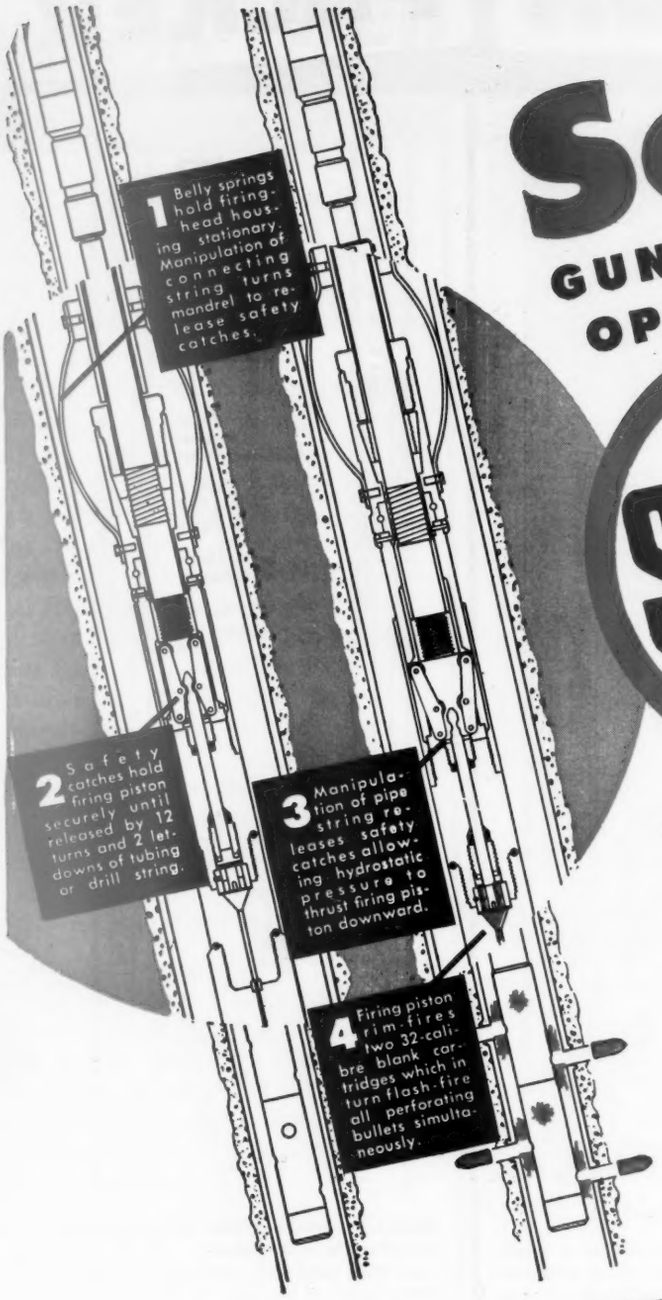
This two-zone hook-up permits washing the upper zone and unloading the annulus; or the upper zone may be killed through the tubing without running a side door choke on a wire line. The casing head used must pack off while the tubing is being raised or lowered. The Packer is set close below the upper zone, and the production string (made up as shown in Figure 3) is run in until the Locator Sub rests on top of the Packer, indicated by a drop in recorded weight on the strain indicator.

To wash the upper zone, or to unload the annulus, the string is raised about 8 feet to bring the Perforated Spacer Nipple above the Packer, but with the lower Tubing Seal Nipple inside the Packer bore. After the upper zone is brought on production through the casing annulus, the production string is lowered until the Locator Sub rests on top of the Packer. Weight of 10,000 pounds, or more if desired, may be set on the Packer, and the lower zone brought in through the tubing, by swabbing if necessary. To kill the well later, the lower zone is killed through the tubing; the production string raised (left view) and the upper zone killed. The production string is the removed from the casing.

Product No. 415-D

Retainer Production Packer

Safer GUN PERFORATING OPERATIONS with SHOOT-N-TEST


1 Belly springs hold firing-head housing stationary. Manipulation of connecting string turns mandrel to release safety catches.
2 Safety catches hold firing piston securely until released by 12 turns and 2 let-downs of tubing or drill string.
3 Manipulation of pipe string releases safety catches allowing hydrostatic pressure to thrust firing piston downward.
4 Firing piston rim-fires two 32-calibre blank cartridges which in turn flash-fire all perforating bullets simultaneously.

The "SHOOT-N-TEST" Gun Perforator Firing-Head ready to fire.

The "SHOOT-N-TEST" Gun Perforator at the moment of fire.

THE JOHNSTON ALL PURPOSE GUN PERFORATOR

THE JOHNSTON "SHOOT-N-TEST" Gun Perforator provides complete safety in every phase of gun perforating operations —maintenance, transportation to and from well, rig-floor handling and running in the well. The "SHOOT-N-TEST" fires *only* when subjected to *both* in-the-hole hydrostatic pressure and precise top-hole manipulation of the tubing or drill string by the driller.

Many advanced features are embodied in the Johnston "SHOOT-N-TEST" Gun Perforator to make it the ideal choice for operators desiring the utmost safety and efficiency in perforating and formation testing equipment . . .

POSITIVE FIRE of all bullets is assured by the flash-hole design of the perforating gun bodies.

EXACT POSITIONING in zone to be perforated is determined by actual pipe-in-the-hole tally.

SELECTED NUMBER OF PERFORATIONS is determined by the number of 4, 5 or 6-shot perforating gun body sections attached to the firing-head.

A MINIMUM OF EXPENDABLE PARTS for each perforating job. No extra equipment other than the "SHOOT-N-TEST" Firing-Head, the Perforating Gun Body Sections and a minimum of reloading supplies is needed.

Write for new descriptive folder!

FOR PERFORATING CASING AND TESTING FORMATION IN ONE RUN

By unitizing the Johnston "SHOOT-N-TEST" Gun Perforator with a regular Johnston Formation Tester Assembly, any designated formation can be perforated and tested in one round trip of tubing or drill string. A quick, efficient method of obtaining water shut-off information, doing exploratory work or testing for actual production.

SHOOT-N-TEST Trademark — FORMATION AND CASING TESTING — JOHNSTON

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"Servicing California-Permian Basin-Rocky Mountain Areas"
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Oil contaminated with mud, water and chemicals from the mud used in drilling the well, is burned off in a flare several hundred feet from Imperial Schoepp No. 1, discovery well of the Golden Spike field. The well is named after the owner of the farm.

Golden Spike Spurs Canadian Development*

SINCE the 13th day of February, 1947, when Imperial's discovery well came in at Leduc, Alberta, oil development in western Canada has tended to concentrate in the Edmonton area. In little more than two years, three new fields in that area—Leduc, Woodbend, and Redwater—containing estimated proved reserves of about 500,000,000 bbl have been established, and present exploratory drilling in other areas is most promising.

The most promising wildcat well—at this time—is Imperial's Schoepp No. 1, situated about 22 miles southwest of Edmonton—near the hamlet of Golden Spike, after which the field is named. The well was spudded in November 25, 1948. The first drill-stem test to give a good oil showing was made on February 11th, and since then tests made at 10 and 20-ft intervals have encountered the thickest producing formation ever found in Canada.

Golden Spike—545-ft of Pay

Schoepp No. 1 was drilled to 6,082 ft, and tests revealed 545 ft of oil zone thickness. Two more wells are being drilled in the Golden Spike area to help in determining the extent of the field.

Spurred by such results, Alberta has now become one of the most active hunting grounds for oil in the world. Today, more than 40 American and Canadian corporations and hundreds of individuals are in the area. Last year these companies spent some $50 millions, and it is estimated that this year they will spend twice that amount in exploration and development.

A large part of this money is going into exploratory work. About 49 seismic crews and 12 gravity meter crews were mapping the subterranean area this spring by geophysical methods. There were 12 core drilling parties, numerous surface geological parties, and 81 drilling rigs; about half the rigs were engaged in exploratory work, and the other half were engaged in development drilling.

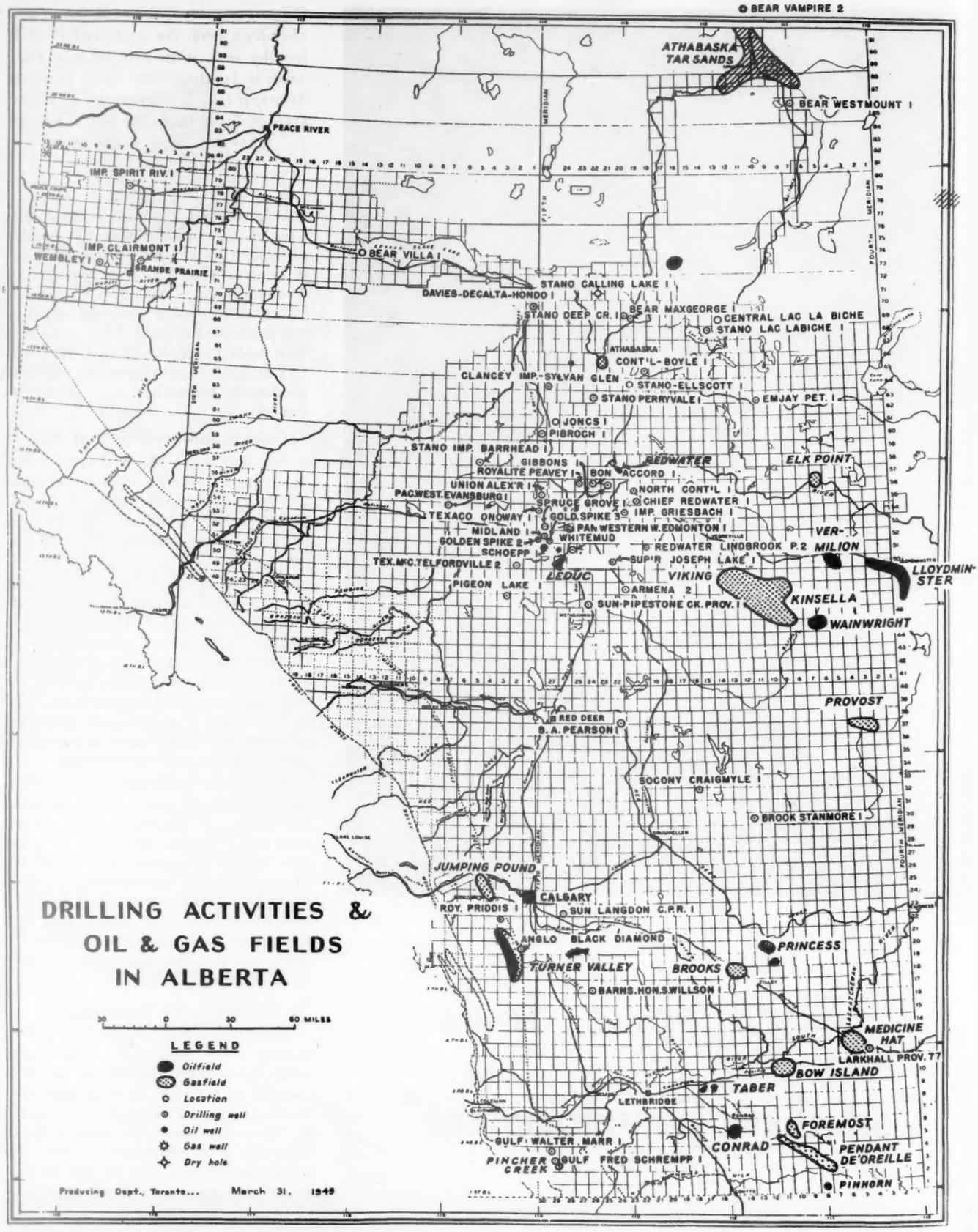
Discoveries Increasing

Since Leduc No. 1 came in as a discovery more than 225 exploratory wells have been drilled in western Canada with results that average out to one discovery—some not yet proved by time—for every 25 wells drilled. That this is an improvement over the pre-Leduc days is due in part to the knowledge gained in the long series of earlier disappointments.

Typical of many of these disappointments along the fringe of the Rocky Mountains is the costliest single drilling project ever undertaken in Canada, Muskeg No. 1 well. It was abandoned last October after 555 days

*Prepared by Imperial Oil Limited, Toronto, Canada, for *The Petroleum Engineer.*

EXCLUSIVE



Imperial's Schoepp No. 1, which is northwest of the Leduc field and about 22 miles southwest of Edmonton, has penetrated 545 ft of pay, the thickest producing formation in Canada. As shown above, the Edmonton area is being widely explored, and several other wells are indicating important discoveries.

PHOTOGRAPHS AND CHARTS COURTESY IMPERIAL OIL, LTD.

Lew Glendinning, a veteran driller with Imperial Oil, makes out reports as Imperial Schoepp No. 1 undergoes initial testing. The drills found an oil-producing formation 545 ft thick.

Imperial Oil and Alberta Government engineers watch Imperial Schoepp No. 1 blow into production, prior to making initial flow tests. Left to right—Campbell Aird and Mark Blaine, Imperial Oil production engineers and Nate Goodman, right, petroleum engineer with the Alberta Gas Petroleum Conservation Board.

of drilling without finding a trace of oil. Five oil companies, Gulf, Imperial, McColl-Frontenac, Shell, and Socony-Vacuum underwrote the cost of the operation, $1,600,000. The bits had reached a depth of 10,709 ft when drilling ceased.

If Leduc had proved up earlier, the chances are that Muskeg operation would not have been undertaken at that time, because of the favorable light that Leduc threw on exploration in the plains area adjoining the foothills.

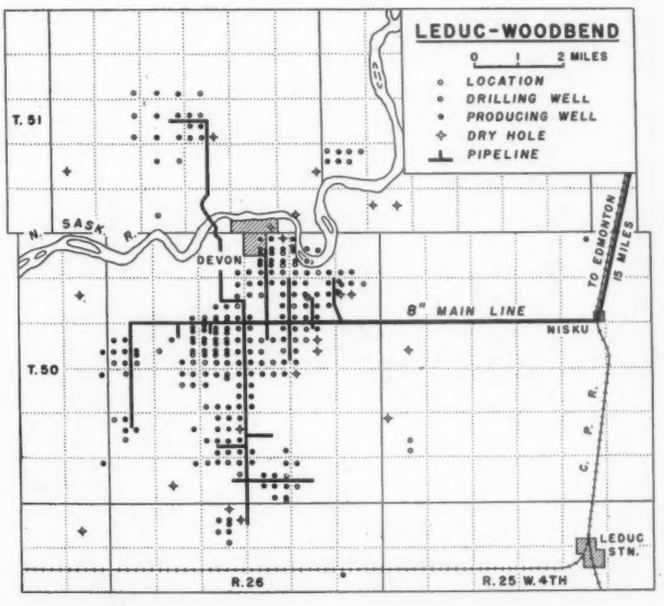
Leduc Opened Plains Area

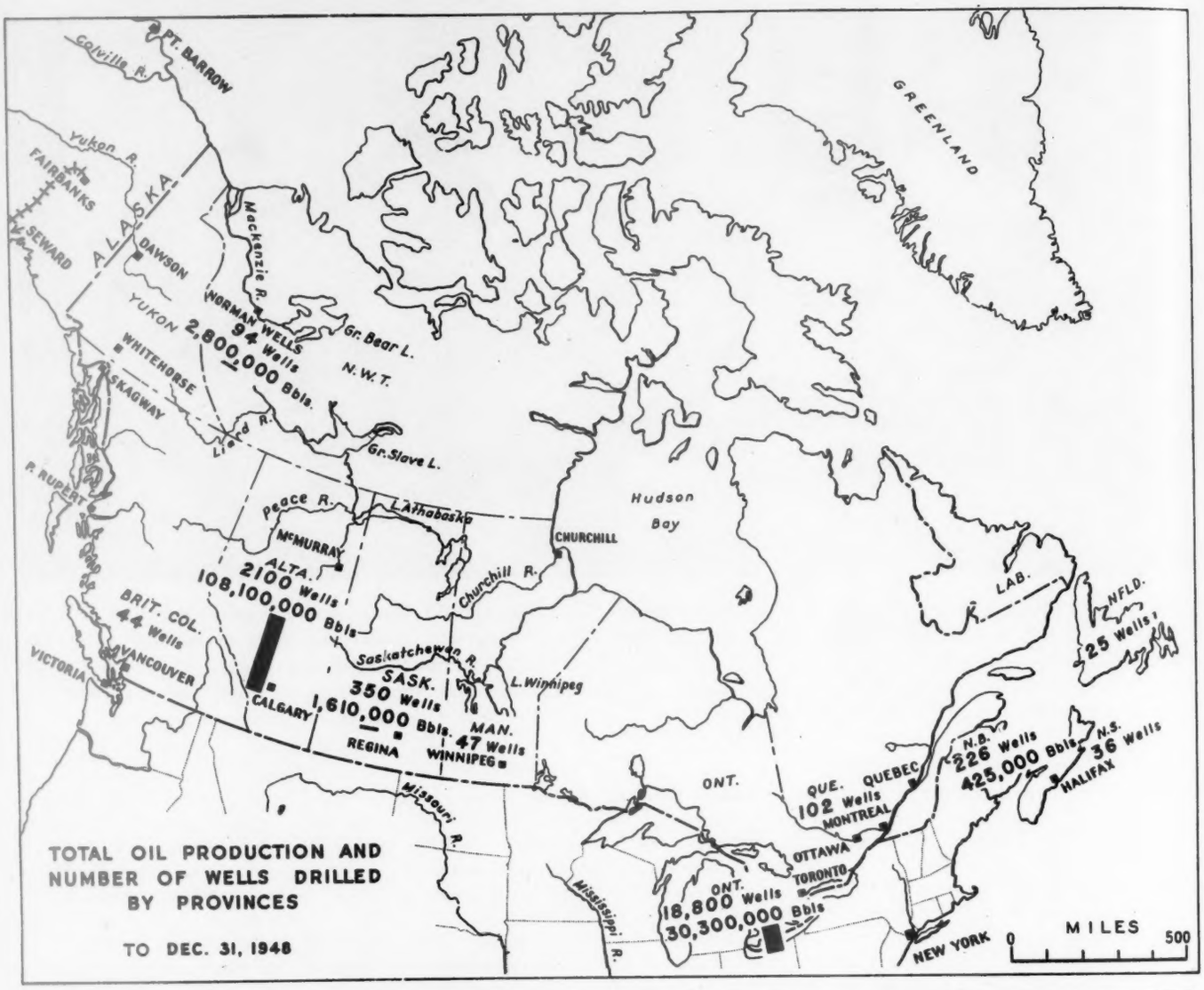
Already near Edmonton—about 18 miles to be exact—the search for oil had produced the Leduc field where the main producing horizon was found by Leduc No. 2 well at 5,375 ft, and it was fast proving itself to be the most productive area discovered in western Canada up to that time. The maximum producing oil thickness was 38 ft. A year later, another highly productive area, the Woodbend field adjoining Leduc, was discovered. Woodbend is regarded by some to be an extension of the Leduc field. Further drilling will be required, however, to determine whether this is the case.

On September 30 last year another strike was made, this time about 35 miles northeast of Edmonton, when Imperial Redwater No. 1 came in at 3,264 ft. The discovery well found a producing thickness of 140 ft.

Redwater Appears Important

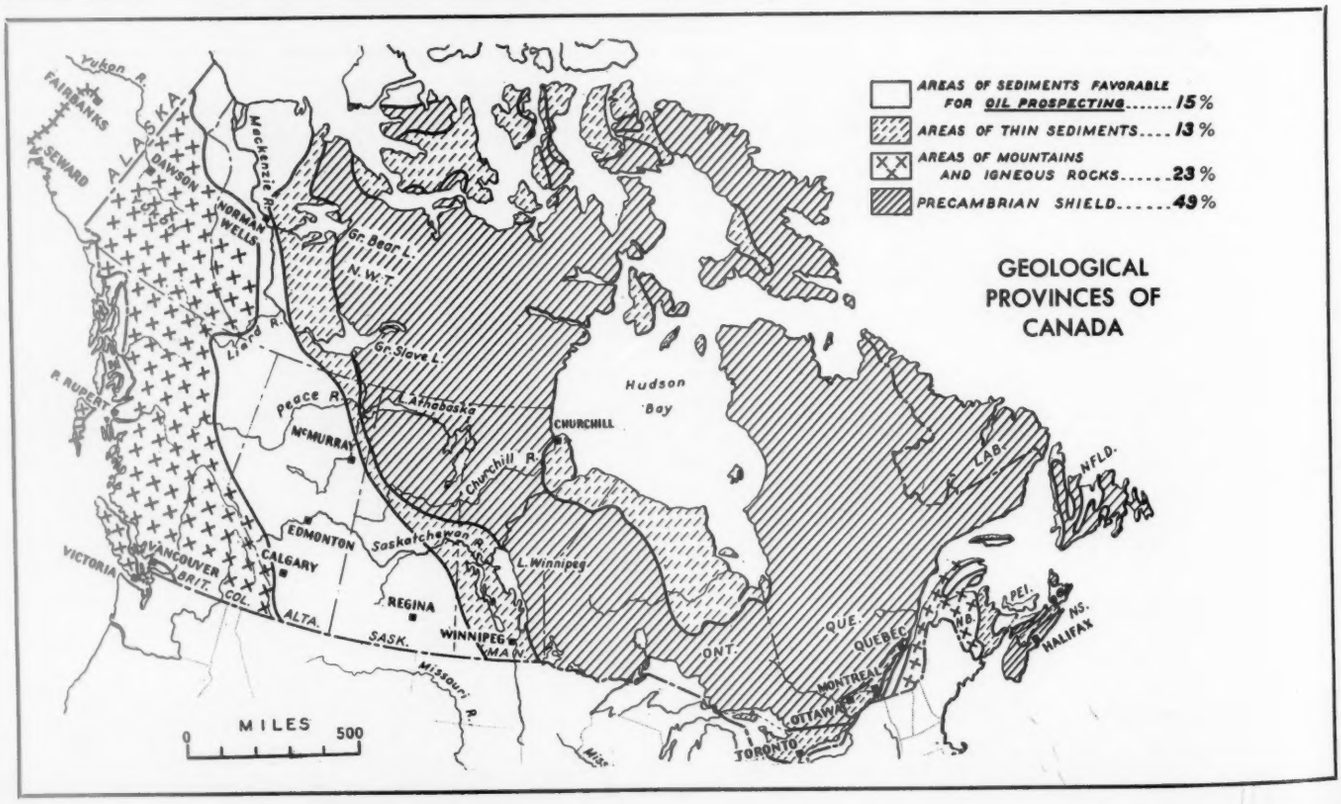
While too few wells have been drilled at Redwater to give a clear picture of the producing area, it is





TOTAL OIL PRODUCTION AND NUMBER OF WELLS DRILLED BY PROVINCES

TO DEC. 31, 1948



George Wright holds the "pulled" pipe steady with heavy tongs as Paul Matvenko pushes over a "stovepipe" to catch mud that will gush out when pipe is uncoupled. Drilling mud is circulated down the interior of the pipe and serves as a lubricant and brings up the rock cuttings produced by the drilling bit.

generally regarded as larger than Leduc. There is only one known producing horizon at Redwater, but it has an average thickness of perhaps two to three times that of the principal producing horizon at Leduc. It is hoped that this field, when fully developed, will yield a comparable production of some 35,000 bbl or more per day.

These fields—Leduc, Woodbend, and Redwater—contain the estimated 500,000,000 bbl referred to earlier. This total does not include anything for five promising showings that are too young to be evaluated properly.

Besides proving up reserves, the work of the past two years has enlarged the oilman's knowledge of the hunting ground. Its area was known before the Leduc field was found, but with Leduc three new geological layers have been added to the known productive formations in Alberta. The oil seeker now has seven geological targets in his hunting ground.

Reserves Increasing

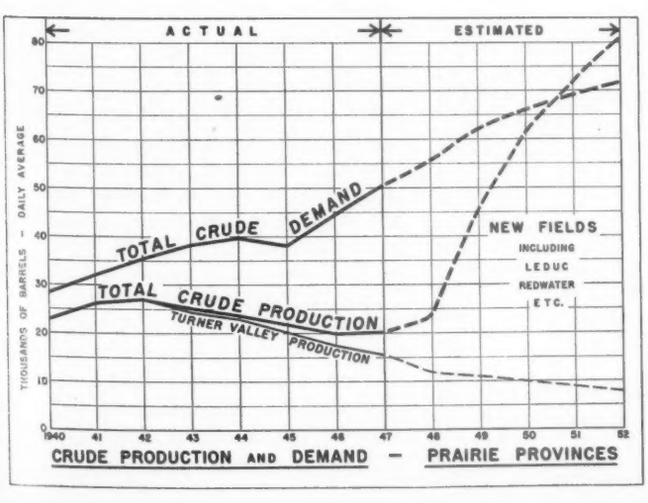
This additional knowledge may explain in part why Joseph Pogue of the Chase National Bank, during a recent visit to Canada, was willing to speculate on the possibility of Canada building reserves of from two to four billion barrels in the next ten years.

It is predicted by some that if the present rate of progress can be maintained, reserves large enough to make Canada self-sufficient in oil may be available by perhaps 1958. This trend is disclosed by the facts that in 1939 Canada produced 7,800,000 bbl, chiefly from Alberta wells, while production in 1948 reached 12,400,000 bbl, and nearly 95 per cent of that amount was produced in the Canadian west. Although consumption has kept pace with the increase in domestic production, it is expected, in the light of present developments, that production will continue to mount but at a greater rate than consumption.

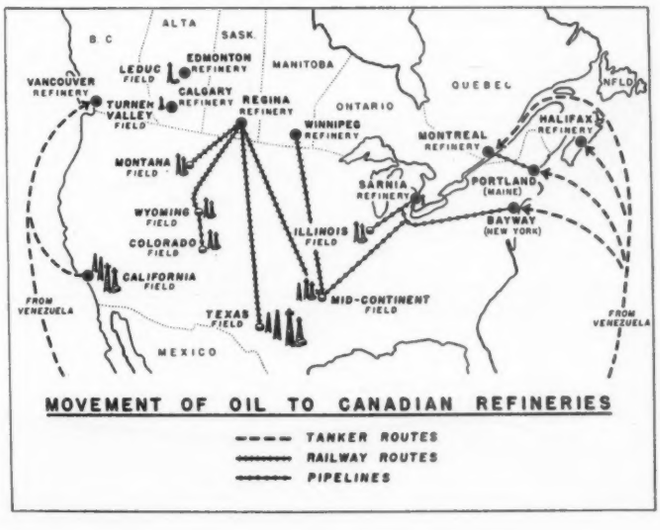
Gas Conservation

A $6,500,000 gas gathering system and gas conservation plant in the Leduc field is now being constructed. It will be equipped to handle 24,000,000 cu ft of gas daily and will recover propane, butane, and natural gasoline. Sufficient equipment has been ordered to allow the residue gas not required for field operations or distribution for domestic and commercial uses to be returned to the oil reservoir.

A new refinery projected by recent


ACTUAL
ESTIMATED
THOUSANDS OF BARRELS - DAILY AVERAGE
TOTAL CRUDE DEMAND
TOTAL CRUDE PRODUCTION
TURNER VALLEY PRODUCTION
NEW FIELDS INCLUDING LEDUC REDWATER ETC.
1940 41 42 43 44 45 46 47 48 49 50 51 52

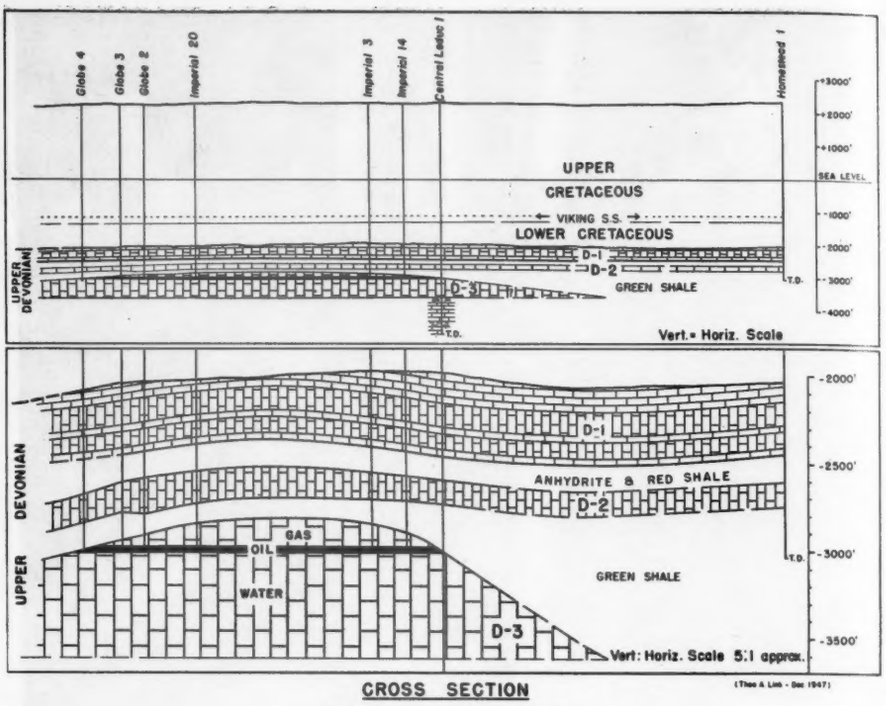
CRUDE PRODUCTION AND DEMAND — PRAIRIE PROVINCES



MOVEMENT OF OIL TO CANADIAN REFINERIES

discoveries is now in operation at Edmonton. It's the former Canol plant from Whitehorse that Imperial purchased as U. S. war surplus. It was dismantled and most of it was trucked piecemeal over the Alaska highway and then by rail to a site outside Edmonton, a distance of 1350 miles. Today the plant is processing Leduc crude, supplied by pipe line, at the rate of 6000 bbl a day. This will soon be raised to 15,000 bbl daily. Two refineries are to be built shortly by other oil companies, and there have been predictions of a third—at Winnipeg, Manitoba.

Other physical evidences of the increased production of oil in western Canada are found in the enlargement of existing refineries and the drying up of the flow of imported crude into the prairie provinces. The increased crude production from new fields and the erection of the refinery at Edmonton have resulted in price reductions of refined products in Alberta and Saskatchewan and of stove and fuel oils in Manitoba.



CROSS SECTION

LEDUC OIL FIELD

Pipe Line Planned

In order to move this increased production of crude efficiently, a 450-mile pipe line from Edmonton to Regina, Sask., is to be constructed. It will cost between $35 and $40 million. The route for the line has been surveyed from the air and is now being mapped in detail. Design work is being carried on and a survey of both surface and soil conditions is being conducted. Laying of the pipe is expected to start next spring.

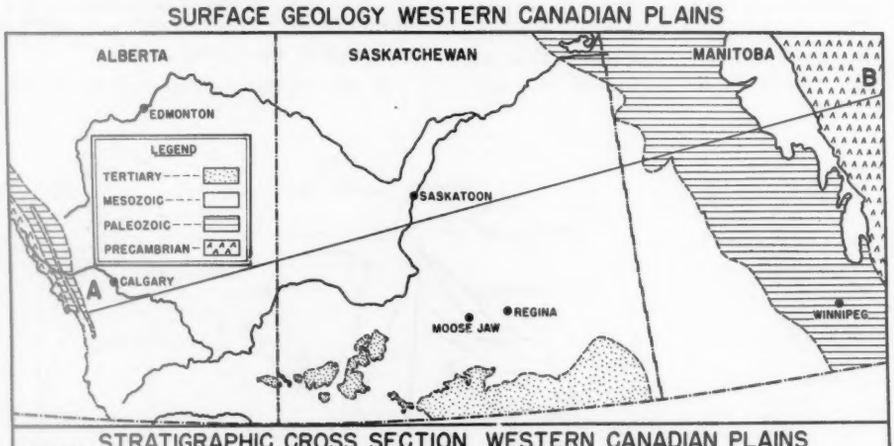
The line as planned will be 16 in. in diam. It will begin with two main pumping stations along its 450-mile route. This will permit it to carry about 50,000 to 60,000 bbl of oil daily from the various producing fields in the Edmonton area. Later on, if developments warrant, six more pump stations could be installed that would enable the line to carry 100,000 to 120,000 bbl daily.

While the pipe line is still in the planning stage and won't be completed until about the end of 1950, the output of oil and the discovery of reserves is growing steadily. So much so, in fact, that even now Alberta production is exceeding refining capacity in the prairie provinces. Only a few months ago the last of the long trains of tank cars that have been bringing oil from the Mid-Continent and Texas regions to Regina made its run. Imported oil is being replaced by lower cost crude from Alberta.

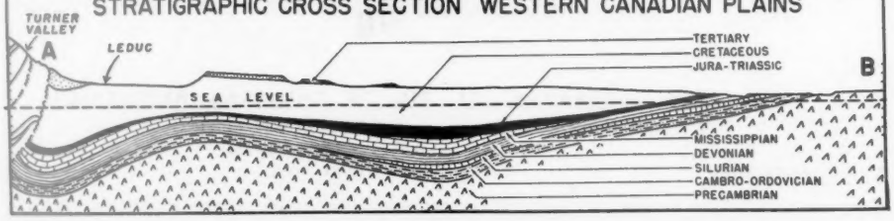
The Edmonton-Regina line, of course, is only a beginning. Much additional pipe line will have to be built to reach the head of the lakes or other potential crude oil outlets. The key to the oil man's problem in western Canada is lower cost transportation to permit him to reach new markets, and the proving of sufficient additional reserves to justify the heavy capital outlay for these transportation facilities.

To sum up, exploration, drilling and production developments in western Canada are now at an all-time high. This accelerated activity dates from the discovery of the Leduc field which is known to be in a basin area of large dimensions. Geological conditions similar to those at Leduc are present over much of this basin area; and this has brought about an enormous effort to find additional oilfields, especially in the area surrounding Edmonton. These successes are pushing the search for oil into other larger and relatively unexplored areas of western Canada that may contain producing zones that some day may make Canada self-sufficient as far as its oil needs are concerned. * * *

SURFACE GEOLOGY WESTERN CANADIAN PLAINS



STRATIGRAPHIC CROSS SECTION WESTERN CANADIAN PLAINS



Drilling Mud Programs for West Texas Wells

C. W. SCAMMAN*

EXCLUSIVE

Less than fifty years ago the rotary rig came into its own at Spindletop. For twenty-odd years thereafter, as rotary rigs multiplied by the thousands and made marvelous strides mechanically, mud was taken very much for granted. It might almost be said that it was used by accident. Water was circulated solely to bring up cuttings. Certainly any such phrase as "a drilling fluid program" was unheard of. It was not until the late twenties that technical papers began to appear on the subject of mud characteristics. Patents began to appear on constituents about the same time. Colloidal chemistry was a well-established science all through this period and the design and control of drilling fluids is definitely a problem in colloidal suspensions, yet, such a word as "thixo-tropic," describing the gel properties of a colloidal suspension, was not then heard in the oil fields.

Many excellent papers built up a literature on the subject during the thirties and, as exploration for oil was going deeper, more and more functions were demanded of a drilling fluid. That these demands were met is history. If the control of the physical and chemical properties of the constituents of the colloidal suspensions used as drilling fluid was accomplished empirically, it was none the less effective.

Now that contracts for holes below 11,000 ft are becoming almost a matter of routine, with a consequent demand for muds up to 18 or 20 lb per gal density, the mud engineer has a wide variety of types of mud and treating chemicals from which to choose. The inventory of a well-stocked mud and chemical distributor might include almost a hundred items.

Clay Mud Systems

Although water-clay mud systems are still very much predominant, several specialized types of mud are coming into more general use. Among these are two types of oil-base mud, oil emulsion muds, and soluble silicate muds. The water-clay systems include red mud, lime base mud, organic colloid (starch mostly), and possibly oil-emulsion muds.

This situation calls for some planning before drilling is begun. Operators are quite aware that the cost of the mud and chemical on a job may be a considerable portion of the total cost of a well. Any preliminary estimate that can forecast costs, even roughly without considering abnormalities, is usually appreciated.

Charting Mud Program

One way of approaching the problem is shown in the accompanying diagrammatic illustration (Fig. 1 on next page.)

This one is admittedly over-simplified for a specific problem, but serves to illustrate a method of forecast that should present, when based on past experience in an area and carried out in enough detail, a fairly accurate picture of what might be encountered and what should be done about it. The graphic mud program is designed for wells that are to be drilled on the central platform structure of the Permian Basin producing area of West Texas. Although this area, centered in Andrews and Ector Counties, gives the mud engineer a great deal of trouble, the problem is theoretically simple.

Given materials that will form suspensions in salt water, the main problem is loss of drilling fluid. The drilling of two rather thick sections in this area is almost certain to occasion mud losses or loss of circulation. Standard practice for large losses is to use cotton seed hulls, graded vegetable fibers, chopped wettable cellophane, and mica. Certain synthetic gums or plastics offer a promise for plugging porous formations permanently, but are as yet experimental.

After penetrating the red beds and entering the Salado salt, the mud program may be laid out according to the drilling program. A preliminary correlation of the two programs is desirable before beginning the job, for they are so interrelated that they are really one. The casing program is of the greatest importance to the mud program, as the mud engineer is no longer concerned with the hole after it is cased. It is common practice to drill with open hole to the Devonian producting formation, and it is not uncommon to go to the Ellenberger with open hole, but an intermediate, or salt string, is set in such deep wells more often than not.

FIG. 2. Nomograph for determining volume of drilling mud pits.

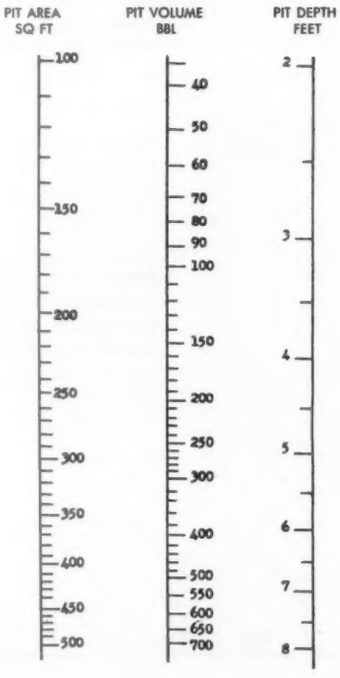
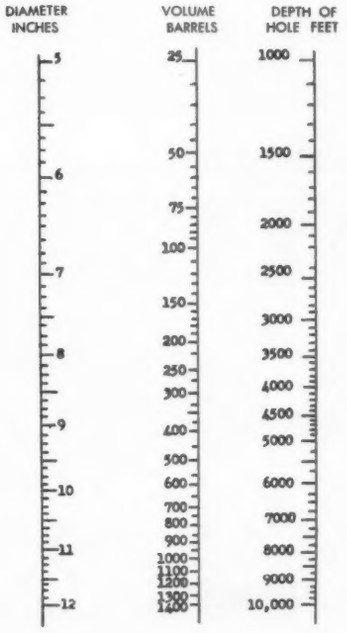
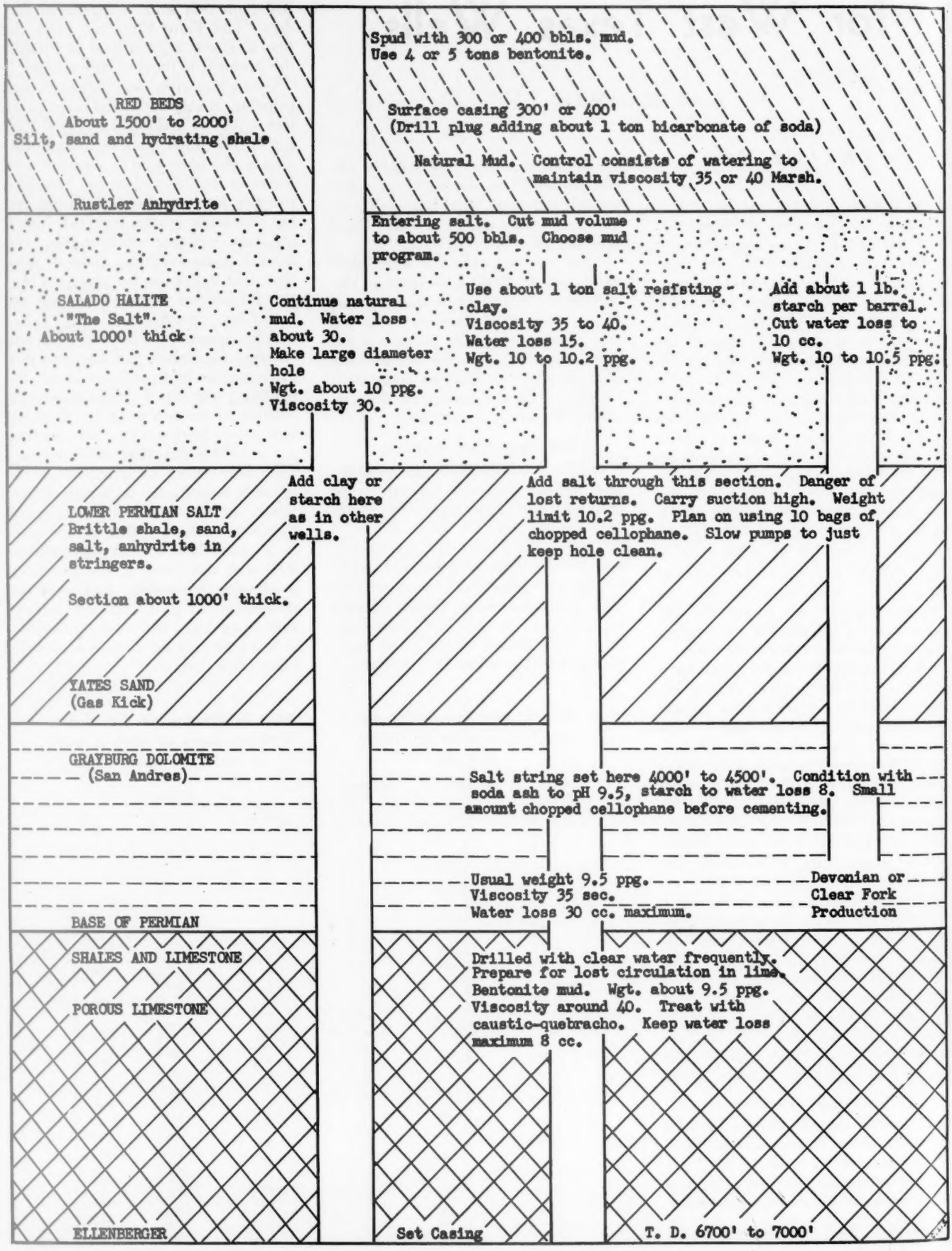


FIG. 3. Nomograph for determining volume of drilling muds in casing or open hole.



*Houston Oil Field Material Company, Inc., Houston, Texas.

FIG. 1. GRAPHIC DRILLING MUD PROGRAMS FOR WEST TEXAS WELLS.


RED BEDS
About 1500' to 2000'
Silt, sand and hydrating shale
Rustler Anhydrite
Spud with 300 or 400 bbls. mud.
Use 4 or 5 tons bentonite.
Surface casing 300' or 400'
(Drill plug adding about 1 ton bicarbonate of soda)
Natural Mud. Control consists of watering to maintain viscosity 35 or 40 Marsh.
Entering salt. Cut mud volume to about 500 bbls. Choose mud program.
SALADO HALITE
"The Salt"
About 1000' thick
Continue natural mud. Water loss about 30.
Make large diameter hole
Wgt. about 10 ppg.
Viscosity 30.
Use about 1 ton salt resisting clay.
Viscosity 35 to 40.
Water loss 15.
Wgt. 10 to 10.2 ppg.
Add about 1 lb. starch per barrel.
Cut water loss to 10 cc.
Wgt. 10 to 10.5 ppg.
LOWER PERMIAN SALT
Brittle shale, sand, salt, anhydrite in stringers.
Section about 1000' thick.
Add clay or starch here as in other wells.
Add salt through this section. Danger of lost returns. Carry suction high. Weight limit 10.2 ppg. Plan on using 10 bags of chopped cellophane. Slow pumps to just keep hole clean.
YATES SAND
(Gas Kick)
GRAYBURG DOLOMITE
(San Andres)
Salt string set here 4000' to 4500'. Condition with soda ash to pH 9.5, starch to water loss 8. Small amount chopped cellophane before cementing.
Usual weight 9.5 ppg.
Viscosity 35 sec.
Water loss 30 cc. maximum.
Devonian or Clear Fork Production
BASE OF PERMIAN
SHALES AND LIMESTONE
POROUS LIMESTONE
Drilled with clear water frequently. Prepare for lost circulation in lime. Bentonite mud. Wgt. about 9.5 ppg. Viscosity around 40. Treat with caustic-quebracho. Keep water loss maximum 8 cc.
ELLENBERGER
Set Casing
T. D. 6700' to 7000'

U-30

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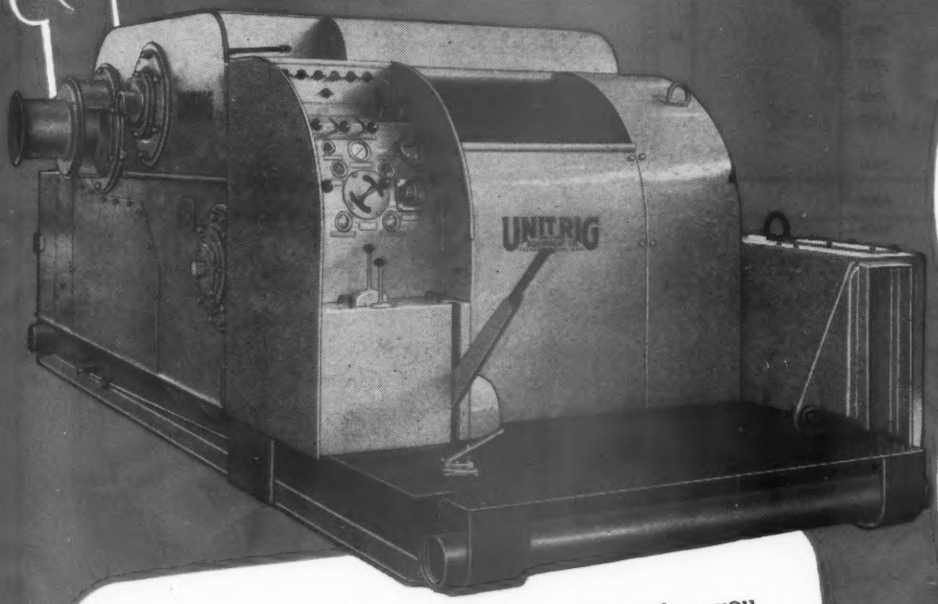

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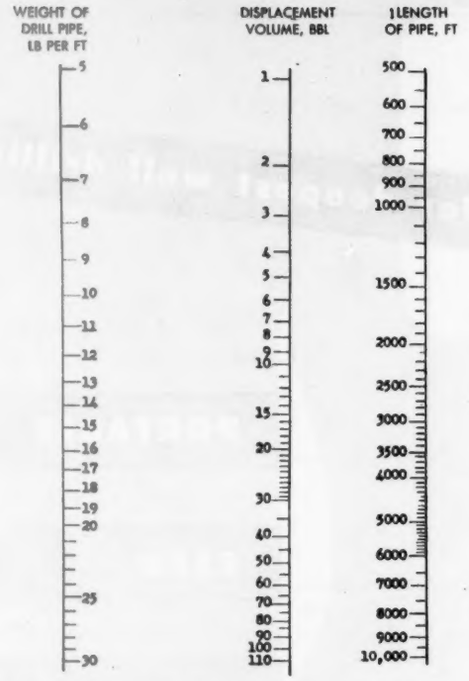


FIG. 4. Nomograph to determine volume displacement due to drill pipe.

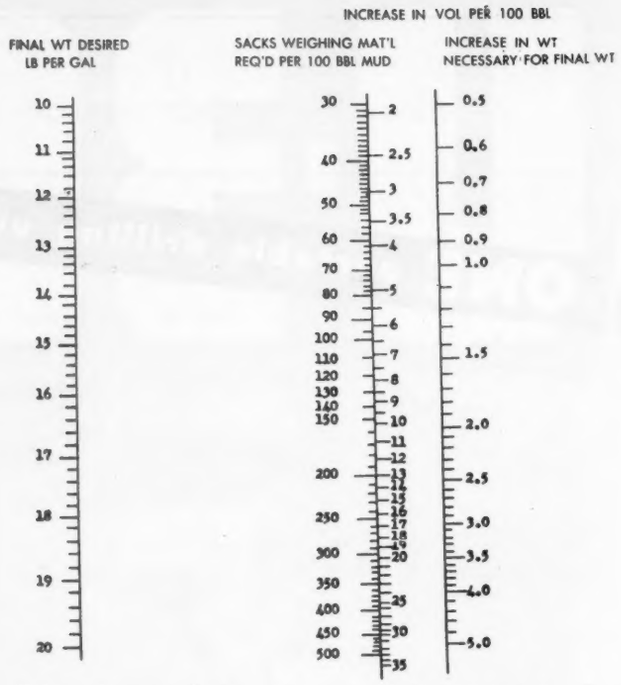

INCREASE IN VOL PER 100 BBL
FINAL WT DESIRED LB PER GAL
SACKS WEIGHING MAT'L REQ'D PER 100 BBL MUD
INCREASE IN WT NECESSARY FOR FINAL WT

FIG. 5. Nomograph to determine number of sacks of weighting material required for weight increases of drilling muds and resulting increase in volume.

Each Well a Problem

No two wells, no matter how close, should be expected to be identical. It might be possible, however, to use interchangeably any one of the three programs shown on the diagram and, broadly speaking, go through to completion.

It is generally considered to be good practice to carry a low water loss mud. There are a few exceptions, however, as it is well shown by experience in West Texas that a driller can make more hole per day in certain hard rock formations when drilling with fresh water. This may be due to cutting action of the bit cuttings. Witness Lo, the poor Indian, chipping arrowheads from a piece of flint with a piece of flint. Another exception may be the hard hydratable shales. If the filtration rate of the mud is very low the result seems to be that the shale surface of the hole is lubricated by a slight penetration of the fluid, merely a wetting of the surface. If the water loss is increased, however, the filtrate may wet more deeply into the shale and allow faster progress to be made.

Against these apparent or temporary benefits of higher water loss mud, are the problems of keeping the hole close to diam and, in the case of hard rock, recovering cuttings of sufficient size to be identifiable by geologists. Holding the hole to diam minimizes the flex of drill pipe, saves on cost of cementing, etc. In case of a fishing job, a hole in good condition should almost certainly show a saving in time and money. A one-trip fishing job should be a big dividend on the extra cost of a low-water-loss mud program.

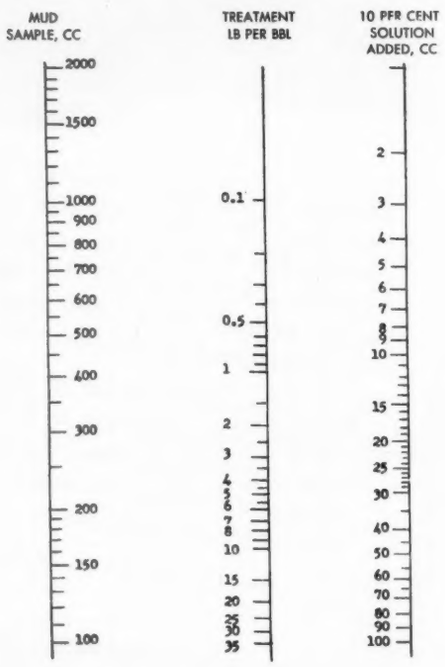


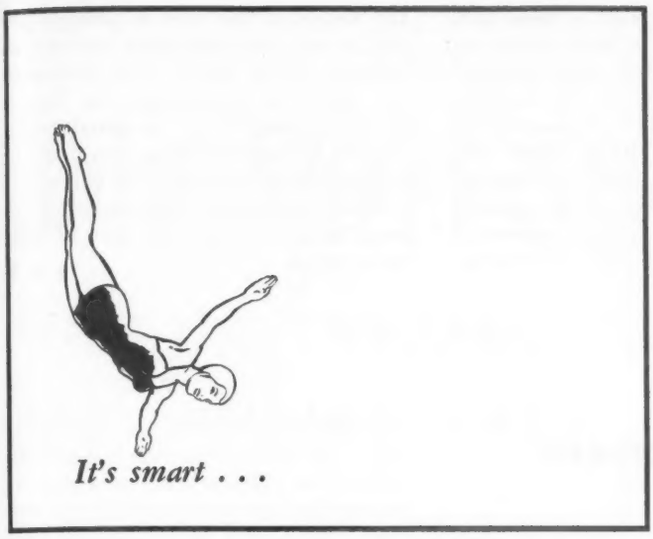
FIG. 6. Nomograph to determine chemical treatment in pounds per barrel using 10 per cent chemical solutions.

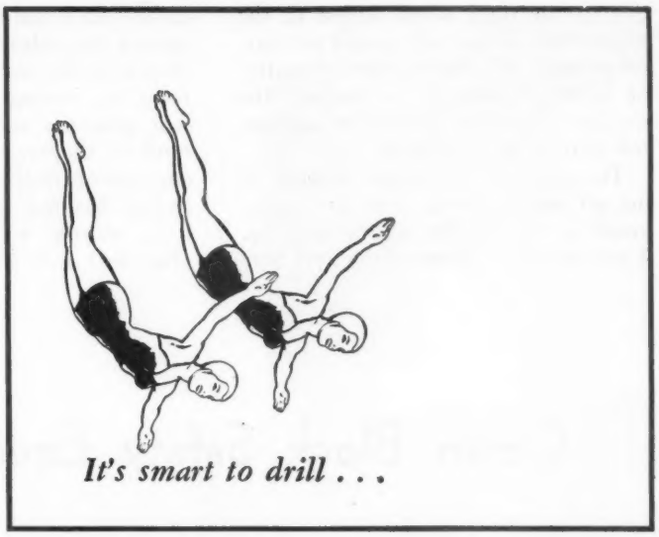
Pilot Tests

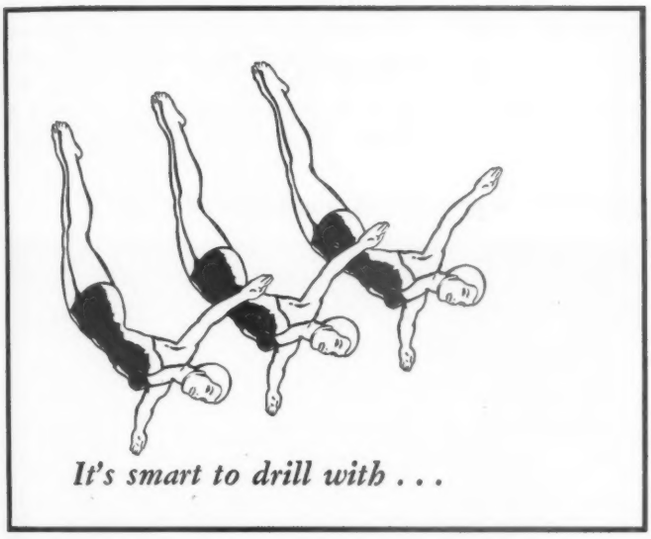
Of paramount importance to the engineer controlling mud characteristics are pilot tests. After it has been determined which chemicals are to be used and in what proportion in pounds per barrel, it becomes important to estimate the total quantity required. The nomographs accompanying this article were prepared by Nash O. Campise† for this purpose.

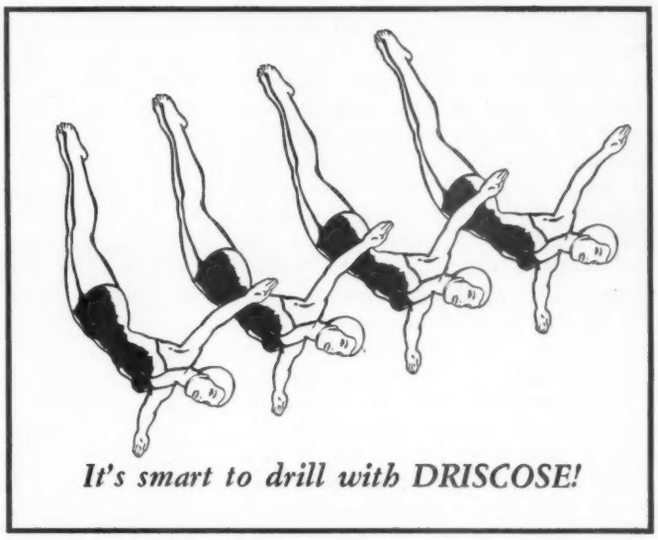
Use of the first three nomographs should give an estimate, accurate to practical working limits, of the total number of bbl of mud in the system. Then, if a compound containing an equal proportion by weight of caustic and quebracho‡ is found to produce a desired reduction in the rheological, thixotropic, and filtration characteris-

†Of the Houston Oil Field Material Company.
‡Such as Dry-Tan.









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Bartlesville, Oklahoma

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tics of the mud when added in the proportion of one-half pound per barrel of mud, then the required quantity of treating chemical is one-half the number of pounds that there are barrels of mud in the system.

The number of barrels of mud in the pit can be read from the nomograph in Fig. 2. The nomograph Fig. 3 will give the volume of the well bore in barrels. From the sum of these two, deduct the volume of mud shown as displaced by the drill pipe derived from the nomograph in Fig. 4. This will give the number of barrels of mud in the system by a quick and convenient method. The nomograph in Fig. 5 is designed to tell at a glance how much weighting material (Barytes) will be needed to increase the weight of the mud in pounds per gallon, and the consequent increase in volume. As an aid to pilot testing in the field, the nomograph in Fig. 6 should be useful, as it is usually convenient to carry treating chemicals in a 10 per cent solution. The volume of solution used may be converted to pounds dry weight by use of this nomograph. * * *

P 425.21

Crown Block Safety Equipment

SHELL OIL COMPANY, INC., installed an extension to the top of all of their drilling rigs in California. The extension consists of a 14-ft heavy steel section with vertical legs that do not slope in with the existing rig. The opening through which the traveling blocks must pass is thus no smaller than the top of the original derrick. The advantage of the extension is that it gives twice as much "safety space" in which the driller may operate the blocks without running into the crown. The drilling derrick's original safety space was only 14 ft.

In conjunction with the extension, an automatic electric eye safety device is also installed to notify the driller when the blocks are near the crown. This device has the additional safety feature of having two activating lights that work in unison whereby both lights have to be obscured from the electric eye in order to activate the warning. This eliminates the possibility of having the catline block off one light and setting off the warning alarm when no danger is encountered.

Another type of safety device being used by Shell for crown warning consists of a limit switch mounted on the water table and a weight riding on the deadline suspended by a cable from the switch. When the blocks reach their upper limit of travel they pick up the weight, allowing the switch to make contact and sound the warning signal.

Equipment is being installed that will operate in conjunction with the crown warning apparatus to shut off the power to the drawworks if the driller accidentally fails to close the throttle in time.

Also to be noted in the accompanying photo is the installation of a canvas engine house. This engine house is entirely portable. It can be dismantled and rolled up when the rig is moved. Its basic construction is on the order of a tent. The high side of the canvas covering is attached to the rig by means of a pole that is attached with clamps to the derrick girts. The lower side of the covering is attached to a similar pole that rests on hinged legs. Steel cables are attached to both ends of the poles and act as a support to keep the canvas covering from sagging. These steel cables are attached to the lower end of the rig base, and, by means of turnbuckles, a constant strain is kept on the cables thereby giving rigid support to the canvas engine house covering. * * *

Shell Oil Company's Alamitos 51, Signal Hill, California.

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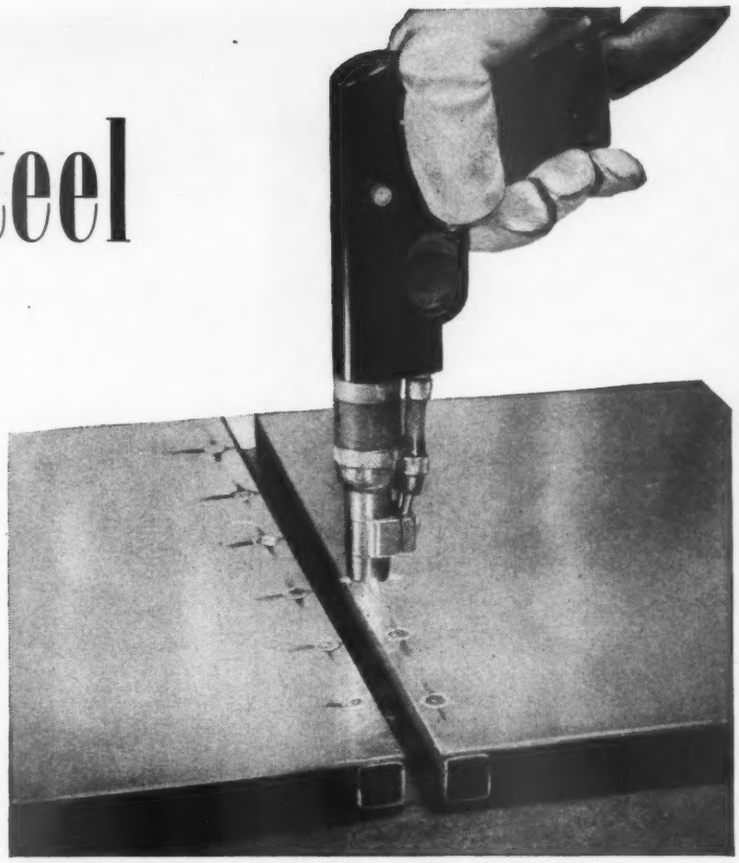

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It's no trick to weld with the HELIARC HW-8 Spot Welding Torch. Just press the "muzzle" of the "gun" against the work and pull the trigger. An automatic timer controls the entire operation. A single hose assembly, standard length 25-ft., connects the torch to the operating equipment. A convenient push-button release on the torch barrel gives easy adjustment of the electrode. These features make the HELIARC HW-8 Spot Welding Torch an ideal production line tool, easy and natural to use and as light and portable as an oxy-acetylene blowpipe.

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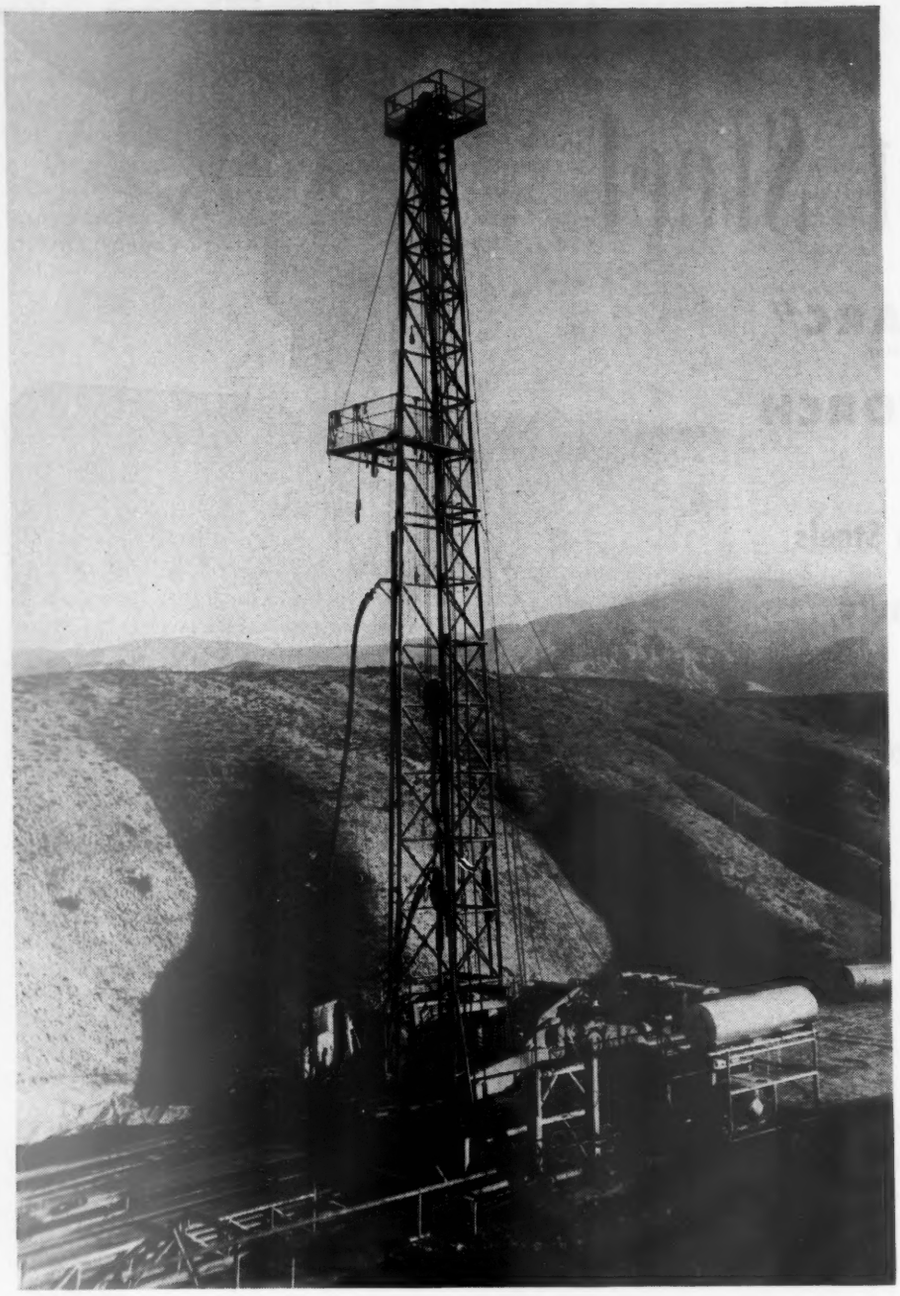

Ninety foot bender guyless derrick of 300,000 lb capacity mounted on portable sub-base.

Spiral Bevel Gears Used in Portable Rig

NICHOLAS A. D'ARCY, JR.

A DRILLING contractor* is operating a 450 hp torque converter equipped drilling rig in Cuyama Valley that features portability, flexibility, and maximum power. The need for reserve power in portable drilling equipment was met by adding a third 150 hp engine. This provides 50 per cent more power than one usually obtains on such a portable rig.

*Walter Buaas Drilling Corporation.

Compounding System

The three engines are operated through a spiral bevel gear compounding case. The idea and design for this transmission† were carried to completion, and the equipment was built.‡ The output shaft of this gear case is parallel to the drum shaft and the input shaft at right angles.

Power from the three 150 hp diesel engines equipped with torque converters is transmitted through three individual spiral pinion gears. The connection between the torque converters and the gear case is through jaw type clutches that provide a positive and simple means of disconnecting any the three engines at will. This quick disconnecting arrangement allows the operator to use one, two, or three engines as needed. None of the engines are partially loaded during normal operation. Diesel manufacturers agree that their engines operate best when they run warm and are operating at a good load.

This particular compounding gear case is designed to accommodate a drive from either end of the output shaft, although on this particular installation only one drive is taken from it. The original thinking behind the design of this unit was to utilize this case either for slush pump drives or drawworks drives. The ability to obtain a high and low speed directly from the output shafts contributes to the flexibility of this design.

Torque Converters

A combination hydraulic torque converter and hydraulic coupling is installed on each of the three engines. The installation of a separate converter on each engine provides the operator with full power from any engine combination he may desire to use. The basic operating characteristics of torque converter equipped rigs allows the driller to engage all clutches before opening the throttle on his engine. This reduces shock loading on the compounding case and entire hoisting system. The relatively high efficiency of the combination hydraulic torque converter-hydraulic coupling results in maximum rotary power and hoisting power with a minimum loss through heat.

Drawworks

The drawworks is a modern light weight 525 hp-capacity unit equipped with air-controlled friction clutches throughout. The drawworks will de-

†By E. A. Bender of Bakersfield.
‡By Regan Forge and Engineering, with Frank Lopker in the role of consulting engineer.

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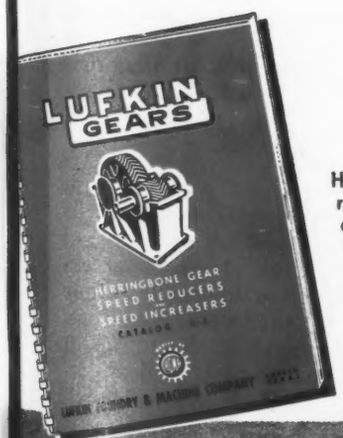

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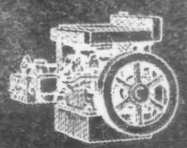

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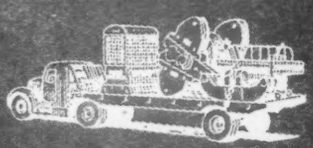

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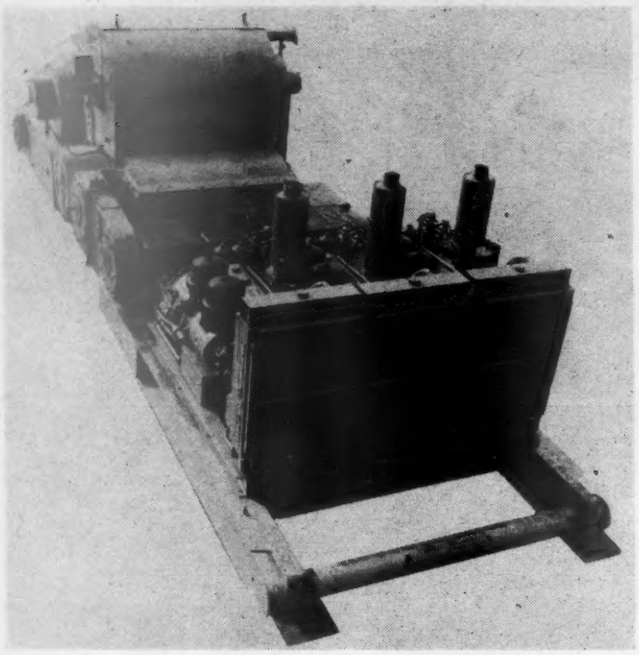

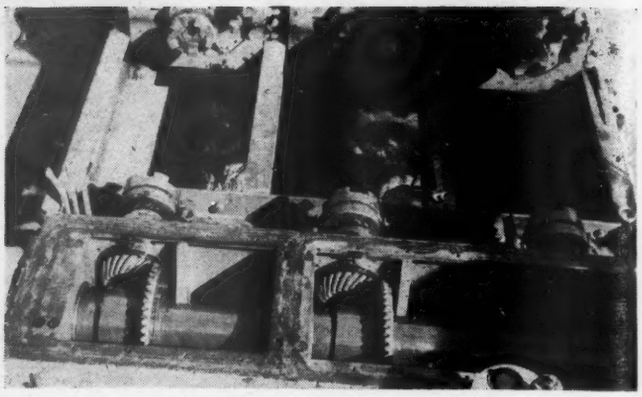

Right angle spiral bevel ring gears and pinions utilized in new gear compounding arrangement.

Three diesel engines driving through three torque converters drive modern air clutch equipped drawworks through spiral bevel gear power compounding case.

velop a maximum line speed of 2400 ft per min and a maximum single line pull of 40,000 lb. A two-speed forward and single speed reverse transmission equipped with air clutches is an integral part of the drawworks.

A 22-in. single hydromatic brake is driven from the drum shaft through a speed increaser. The engine throttles and engine emergency cut-offs are all controlled by compressed air. This drawworks has ample capacity for 6500-ft drilling with 4½-in. drill pipe. The three diesel engines provide suitable power for this work.

Portable Derrick

A 90-ft 300,000-lb capacity guyless derrick is mounted on the main substructure. This type of derrick has found wide acceptance among California contractors due to the ease with which it can be set up and moved. The derrick is self-supporting although two permanent guys are attached to the main sub-base as an erection safety measure.

The entire front of this derrick is open and the four legs are spaced equally around the rotary table resulting in a direct transmittal of load from the crown block through the derrick legs to the sub-base.

Ample space is provided on the sub-base and in the pipe racking column for 100 stands of 4½-in. pipe. All mud lines, stand pipes, and electric connections are attached permanently to the derrick. The pipe racking platform is hinged for compactness in moving.

Three 150 horse power diesel engines each with its own torque converter mounted at right angles to drumshaft in a compact 8 foot wide package.

Pipe Baskets

Portable pipe baskets are used for storing and transporting the drill pipe. These baskets are all welded units 7-ft 6-in. wide and long enough to accommodate singles of drill pipe. The pipe is nested in the baskets and picked up as required with the cat line. When a well is completed, the drill pipe is laid down in the baskets, and the basketful of pipe is skided as a unit into a truck. This method of handling and transporting drill pipe saves several hours per move and eliminates the hazards of rolling and unrolling drill pipe on and off a truck.

Conclusions

This modern, light, portable rig is a tribute to the foresightedness of its designers.* It takes full advantage of light weight, high speed diesel engines, combination hydraulic torque converters and hydraulic couplings, air clutches, modern light weight drawworks, and portable guyless derricks. It has ample power and flexibility to drill economically to 6500 ft or deeper. It is sufficiently portable for economical use in 2500 to 3500-ft drilling programs. ★ ★ ★

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EMULSION DRILLING MUD

ANOTHER MAGCOBAR MUD FOR SPEEDING DRILLING, CUTTING COSTS AND IMPROVING PRODUCTION

JEL-OIL "E", a ready-mixed emulsion compound which is easily added to conventional muds to give a stable oil emulsion mud, reduces torque and circulating pressure, speeds drilling, makes bits last longer and cuts down the number of trips. JEL-OIL "E" also prevents hole trouble and water blocking of pay sands. Emulsion mud is low in cost.

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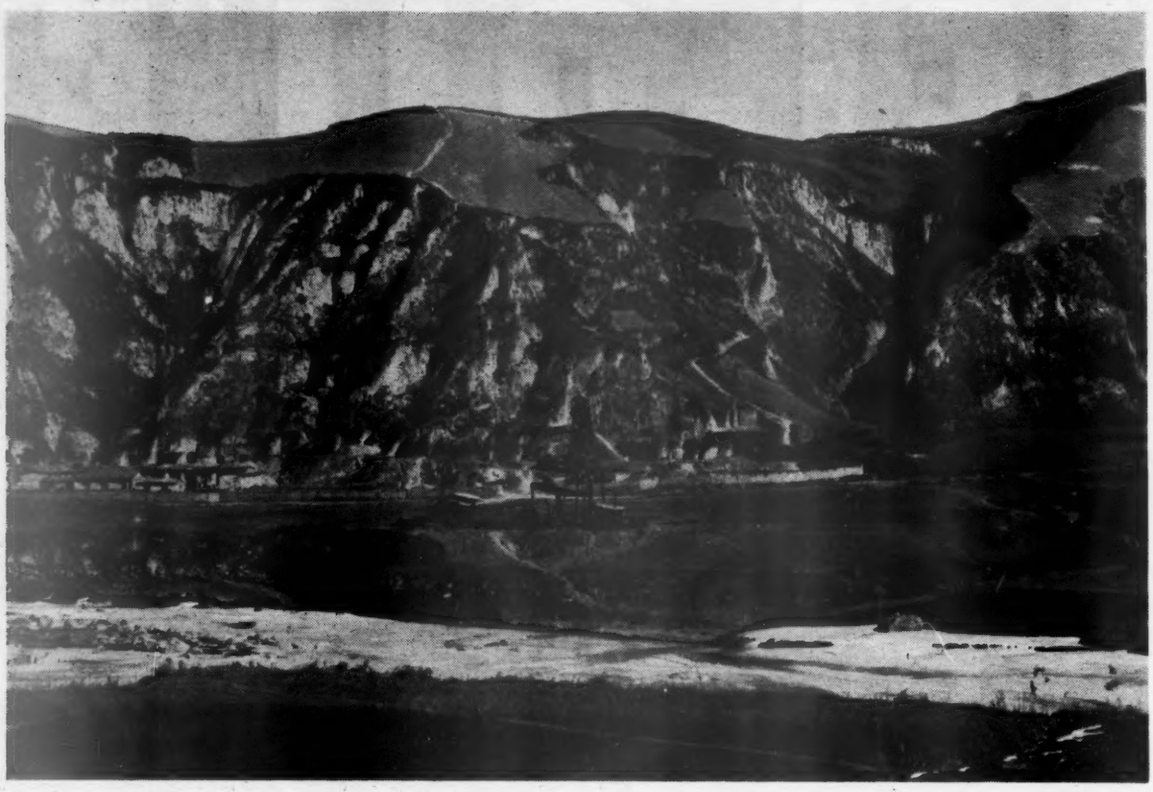

Rig on location is planned as last well in field.

YENCHANG OIL FIELD

MAJOR JOE R. WHITE*

EXCLUSIVE

THE Yenchang oil field is situated in the Shensi Province of China, along the Yen River, and approximately mid-distance between Yenan, the capital of Communist China, and the Yellow River. (110 degrees East Longitude, 37 degrees North Latitude). This is the only field being produced by the Border Region Government, and though production is very limited and, in our conception, unprofitable, it has been necessary for the Red Government to expend men and nearly all of its limited equipment in an attempt to increase the production. This necessity may be realized when it is known that kerosine, gasoline, and candles were the only medium of exchange with the people to the south of the blockaded region. During the war this was the only method of trade through

Aerial view of the severely eroded loess formation. The "holes" at the bottom of the picture are entrances to the cave homes of the Communist Chinese.

*Major Joe R. White spent 2 years in the CBI Theater and was offered the opportunity of a special assignment at the Yenchang oil field. He was graduated from Texas A & M in 1940 in petroleum engineering.

IF YOU WANT

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POSITIVE ACTION
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THE GROVE
PRESSURE
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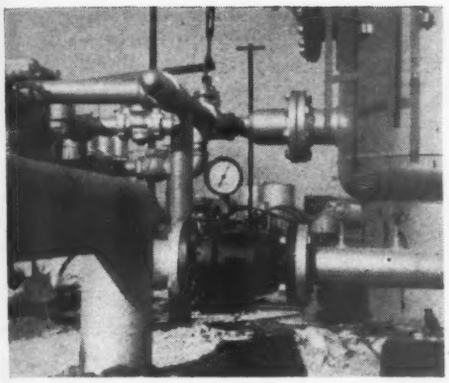

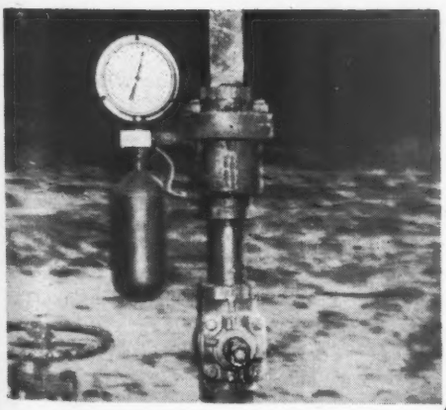

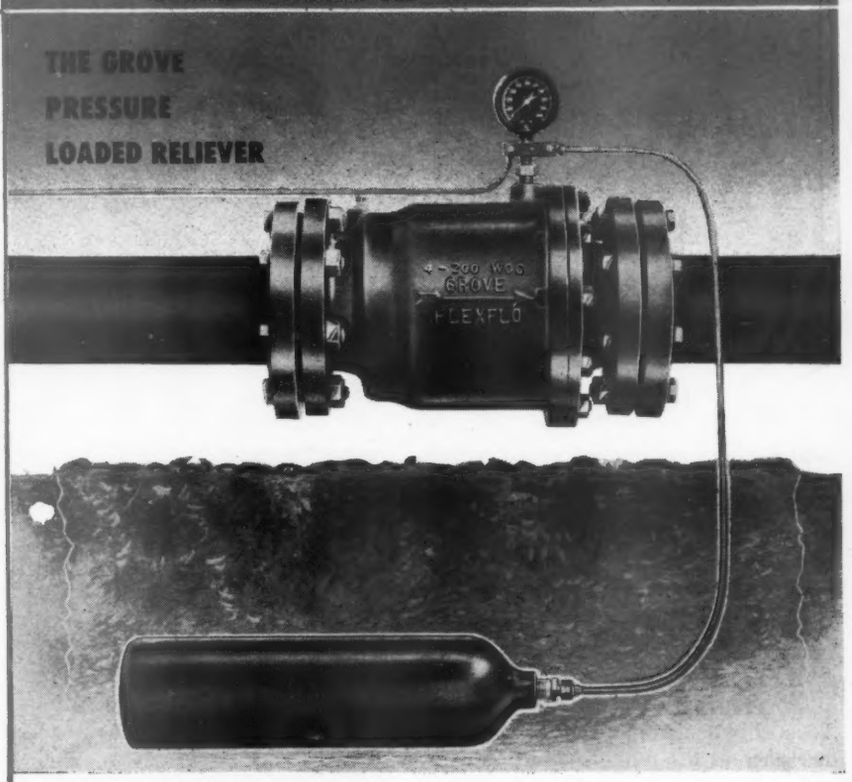

The Grove Flexflo Pressure Loaded RELIEVER is appearing all over the oilfields. Oil men are beginning to discover its flexibility —its adaptability as either a Relief Valve or Back Pressure Regulator on constant or intermittent flow. Incorporating all the outstanding features of the Grove Flexflo, the Model 888 gives instant response to the smallest line pressure variation. The rubber-tube is smooth and positive in action, eliminating seepage and leakage . . . offering sure and certain operation when installed in parallel with code-required relief devices.

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Map showing location of Yenchang field.

which the Communists could obtain the essentials of life that they were unable to produce. Therefore, in spite of the high costs of production and the difficulty in transportation of the crude and the finished products, it was necessary that this venture be maintained.

Discovery

A Japanese engineer drilled the discovery well in 1906. He evidently based his decision for drilling on the presence of the numerous oil seeps in this region. According to Chen Tsunhsia, an experienced oil field worker who now manages the field, the discoverer drilled four wells, two of which yielded minor production. He finally abandoned the project in 1910 due to political and transportation difficulties. The Republic of China and Socony-Vacuum Oil Company operated the field from 1910 to 1935. The Socony-Vacuum Oil Company drilled five wells between 1914 and 1916 under contract with the Republic of China, but abandoned the field chiefly due to the lack of transportation, since there are neither roads nor railroads in this region. They left all of their equipment on location, however, and this equipment is still in use.

In 1935 the Red Army completed its 6000-mile march from south China and immediately took over the operation of the refinery, which is in the town of Yenchang, and the operation of the field some five miles further up the river.

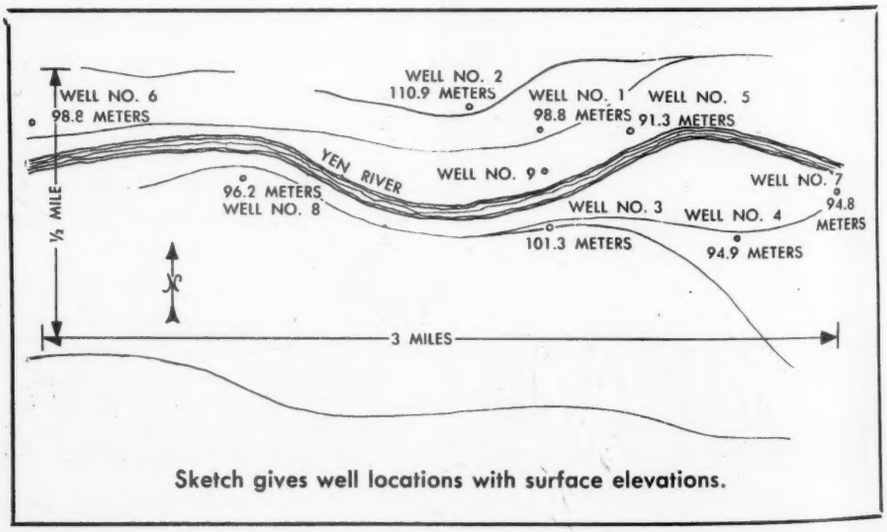
The field now consists of eight wells; the five drilled by Socony-Vacuum, one drilled by the Reds, and two drilled by the discoverer. (The locations of the two non-producing wells drilled by the Japanese were not known by the personnel of the field.)

The depth of these wells varies from 140 meters* to 180 meters† and the relative location of the wells may be seen from the map of the field. At the present time three wells, Nos. 2, 3, and 6, are being pumped by hand. In this process, eight coolies consist of a team—they turn a big hand-made wheel, which operates the walking beam. The home-made pumps, similar to the conventional type bottom-hole pump, are hung on a string of 2-in. pipe. The sucker rods are a mixture of those left behind by previous developers, and reasonable facsimiles made out of iron rails stripped from captured railroad tracks. The other productible wells, Nos. 4, 8, and 7, are not used for there are only enough sucker-rods to pump three wells.

It was reported that well No. 1 came in as a flowing well under consider-

*About 465 ft.
†About 600 ft.

Yenan field taken from well No. 3 looking west. Arrow points to well No. 6.



Sketch gives well locations with surface elevations.

What is STANDARD?

THE word standard has lots of meanings. There are "high" and "low" standards. In equipment, standard can mean "like everybody elses," or "not deviating from the established way or method."

To Maloney-Crawford the word standard means "constant improvement." For, Maloney-Crawford tanks, separators, and treaters are made under a standard that requires constant experiment to find better methods, provide better workmanship, a better finished product, and last, but not least, better field service.

What is high standard to Maloney-Crawford today, we hope will be a low standard tomorrow. If there is a better way, Maloney-Crawford will attempt to find it.

MALONEY CRAWFORD

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Well No. 3 in Yenchang field.

able pressure at a depth of 180 meters. After trying for two days to cap the well, however, and meeting with no success, and lacking suitable containers to hold the oil, the well was backfilled with rock and mud and finally killed. Upon redrilling no production was encountered.

Production

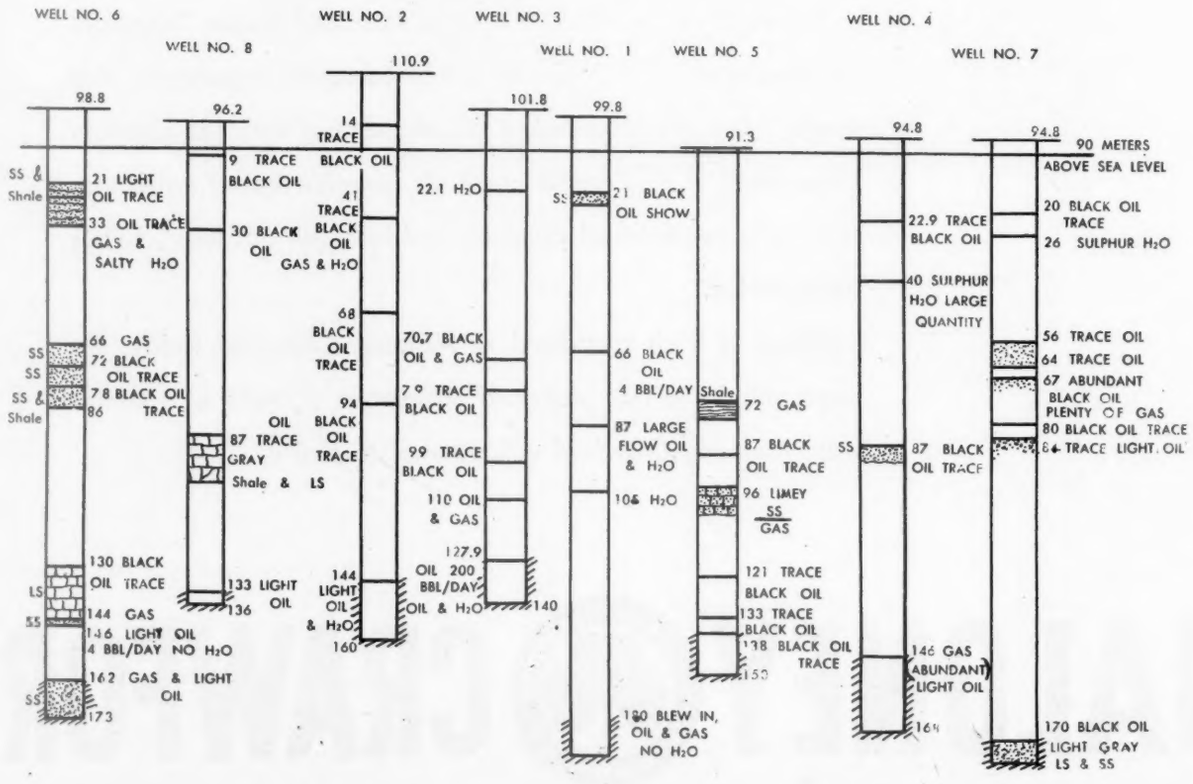
No. 2 well is producing paraffin base oil at a depth of 144 meters. It originally yielded 10 bbl per day but has now declined to a rate of 2 bbl a day. Since there was only a minimum of casing and no cement, a surface casing was set in an effort to eliminate surface water; however, in this well the water ratio was 10 to 1. Yet this operation, born out of necessity, was an economical one for them.

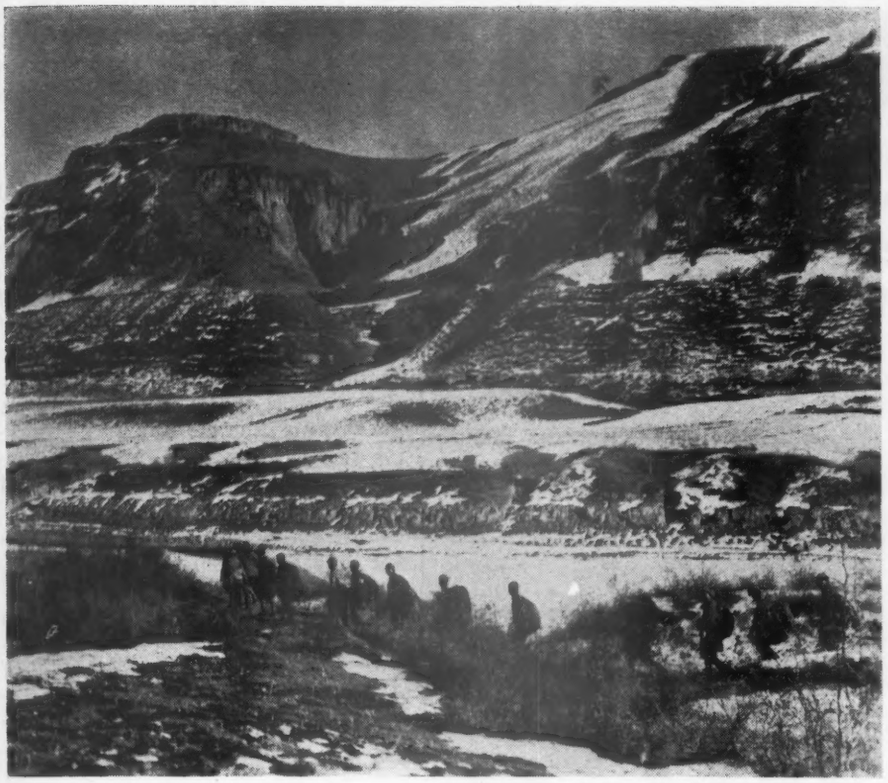
Well No. 6 is producing 3.5 to 4 bbl of oil a day and no water at a depth of 173 meters. The production sand is the same as that in well number 2.

The manager of the field had requested that I bring in an explosive to shoot well No. 3, which had de-

Exact copies of Yenchang West ⟷ East well logs.

(Elevations and depths in meters. Light oil and dark oil refers to color.)





Communists soldiers on a forced march to Yenchang to move by hand the boiler left by Socony-Vacuum Oil Company to a factory in the vicinity of Yenan.

clined from 20 bbl per day, no water, to 2½ bbl a day with a water ratio of 20 to 1. After studying the well log it was decided to shoot 35 lb of Composition "C" at a depth of 132 meters in an effort to enlarge the hole. It was felt that if it killed the well nothing would be lost since they could then pump No. 4 but, on the other hand, perhaps shooting would increase production. After the No. 3 was shot and bailed, the production was 22 bbl of

Looking east along the Yen River between Yenan and Yenchang. Note the loess formation overlaying beds of sandstone and conglomerate.

ONLY
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CEMENTING
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FULL
DOWNWARD FLOW WHILE RUNNING CASING

FULL
LATERAL FLOW WHILE CEMENTING

FLOAT COLLAR

SHOE

CAMERON - NUWELL FLOAT COLLAR AND SHOE shown in cross-section. Note how the slotted cage in the Float Collar retains the large back-pressure ball, but the smaller diverter ball, shown entering shoe, readily passes thru the Float Collar to seat in the shoe and seal the axial hole.

Application of pump pressure shatters diaphragm which permits all fluid to flow through side ports.

With CAMERON-NUWELL cementing equipment, control of fluid-flow direction during cementing procedure is as simple as the manipulation of a two-way valve.

When running casing, the entire flow of fluid is directed *downward* through the nose of the Shoe at high velocity in order to wash down any bridges which might be encountered.

BUT — when the casing is landed, *lateral flow* is required for a good cement job.

Operators interested in obtaining a good primary cement job, fewer costly squeeze jobs, are invited to send for descriptive literature.

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Yes..we're talking price!

BECAUSE THE FACTS CAN PROVE IT

* One major oil company has the upper 2000 feet of tubing coated with "TK-2" Special-Kote in 62 oil wells located in Louisiana . . . at an average cost per well of only $480. Prior to coating, it was necessary to scrape the wells for the removal of paraffin every 3 to 7 days.

"TK-2" Special-Kote is equally successful in preventing paraffin adherence in flow lines, valves, and related equipment.

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oil from 16 hr of pumping and there was no water associated with it. (This production was sustained for at least three months. I have had no report since that time.)

Refining

When the oil is produced it is piped to hand-made tanks lined with slate. The water is drained off and once a week the oil is poured into bamboo casks lined with slate and transported by mules or slid on the ice-covered Yen River to the refinery. The capacity of the refinery is 320 bbl per day and consists of three crude stills. At the present time the refinery is working only part time and during the daylight hours only, since they have had over 30 fires caused by their kerosine lamps. The function of this refinery is not only that of distilling the crude, but also for the purifying of the paraffin and the making of candles, which are superior to any other candle available in North China. The foreman of the refinery stated that the specific gravity of the crude is .82 and that the gasoline cut runs from .72 to .75 specific gravity and amounts to 7 per cent of the total crude produced. The kerosine cut runs from .75 to .78 specific gravity and amounts to 43 per cent of their crude. The refiners were unable to obtain a lubricating oil since they had no method to gravitate the paraffin fractions.

The operators were extremely desirous of obtaining drilling equipment and extending the field. They felt they could drill one more well, No. 9, with the equipment they had but that the worn bits, frayed cable, and often patched boiler could not stand up for more than this well. They were also anxious to deepen the wells but again were limited by the equipment. The boiler was left behind by the Japanese in 1910 and was the only usable one since they could not get parts to repair the one left by Socony-Vacuum; the cable and bits were those used by Socony-Vacuum from 1914 to 1916.

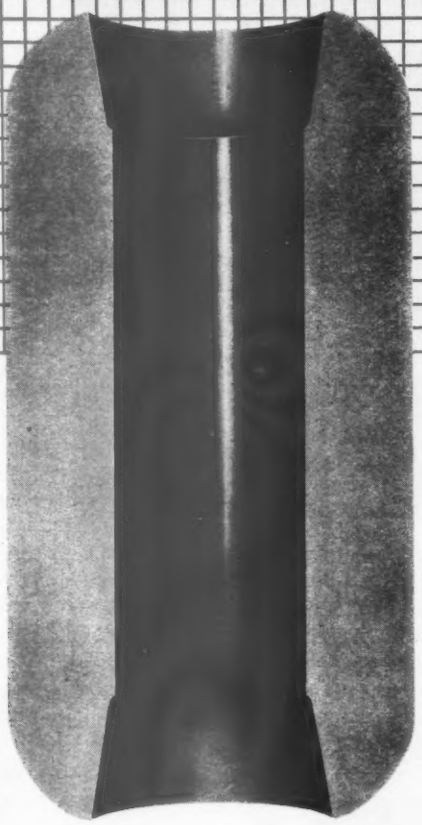
Geology

This area is covered with eroded loess some 500 ft thick. Under the loess are beds of sandstone, and conglomerates. There was little indication of folding and very minor dip to the beds of sandstone and conglomerate. These Mesozoic formations are reportedly overlaying a carboniferous coal series, which outcrops some 15 miles SSE of the field where there are coal seams 3 to 4 ft thick. There are numerous oil seeps along the Yen River to Yenan and in the vicinity of Hwanhsien to the west.

Because of the briefness of the old well logs and the probable inac-

Cross Section of Quality

or why Patterson-Ballagh Casing Protectors last longer

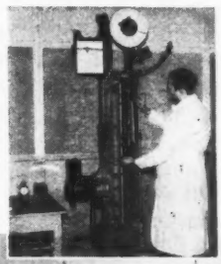


These tapered recesses allow less stretching at the ends, keeping stress here less than in thick body when Protector is installed, thus eliminating tearing at this vulnerable point.

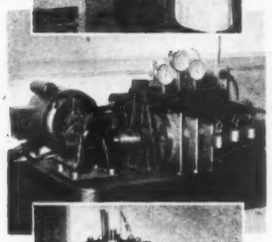
Quality Protectors come from quality workmanship in the shop and laboratory. This new shock-proof, tear-resistant Casing Protector represents endless hours of testing in both laboratory and field. Now it is *field proven* and ready for your drill pipe.

This new design meets the rough use and abuse of deep drilling. Engineers know that rubber under less stress will withstand more shock and tearing action than highly stressed rubber. Since the ends of a protector take the greatest beating down the hole, the tapered ends of the new Patterson-Ballagh Protector are not stressed as highly as the body, yet they grip the drill pipe firmly and prevent any fluid from getting between the rubber and drill pipe. These resilient ends allow the Protector to absorb shock and resist tearing action at this point.

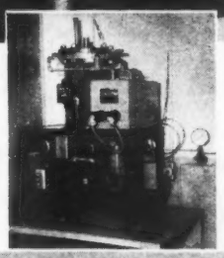
To further insure proper rubber stress, *every Protector is designed for one, and only one, size drill pipe.* Call your Patterson-Ballagh man and have a new Protector installed on every length of drill pipe.



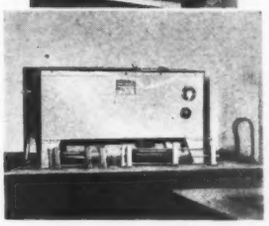
Tensile testing machine tests rubber samples from each batch of rubber to insure quality control.



This machine tests the abrasion-resistance of rubber samples—another example of why we know our Protectors will give long wear.



Rubber samples are aged, equivalent to two years, in a few hours time in high pressure oxygen ageing equipment.



The resistance of rubber under tension to hot oil is determined in this bath that simulates actual operating conditions.

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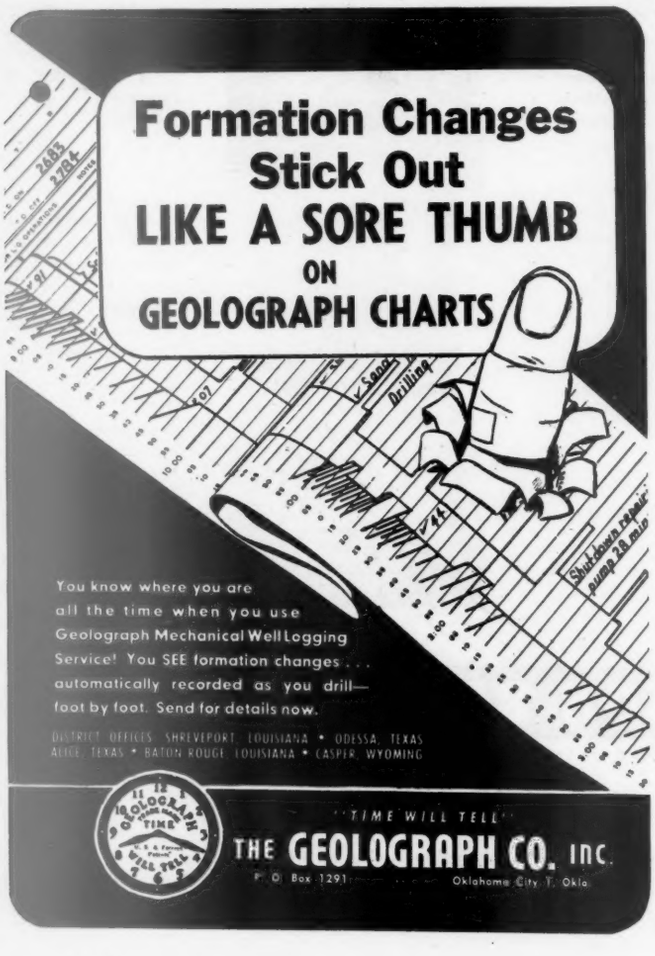
Ready to run shot in well No. 3.

curacies of measurement and identification of formations, it is difficult to define the type of shallow structure present. Using the so-called "light oil" formation as a basis, it can be seen that there is closure on the flanks from well No. 6 and well No. 7 with the high point of the structure in the vicinity of well No. 1. It appears from the logs of wells Nos. 1, 2, 3, and 5 that the producing formation slopes upward in the direction toward wells Nos. 1 and 3. It seems feasible that the structure is either a pinched out sand or perhaps a faulted structure.

In evaluating the importance of this field it must not be judged by American standards and American production. Rather it should be judged on the basis of relative importance of petroleum and its by-products to an uneasy and undeveloped China. The exchange of China is not in how many dollars are possessed, but what those dollars will buy or what power they will give. In this light the true importance of the Yenchang oil field to the Communist Government may be realized, as it provided a means of bartering for cloth, machinery, and other critical items which could not be made. Now that the Red Government has broken out of the blockaded area and is spreading its influence and control over greater territory, the future of this field is debatable. If modern drilling equipment and methods are introduced it is possible that several other shallow, and perhaps even deep structures, may be developed. On the other hand, the Communists may abandon the Yenchang oil field as an uneconomical venture, unworthy of the expenditure of men and equipment. ***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Baash-Ross News

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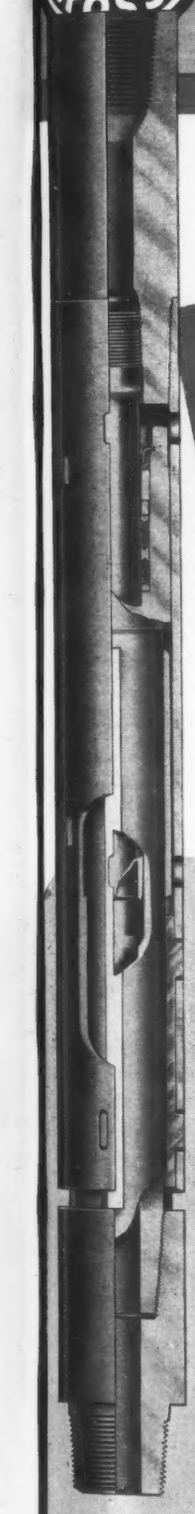
OUR 29th YEAR



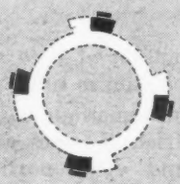
Here's the kind of RUGGED CONSTRUCTION you need for SUSTAINED OPERATION on today's drilling operations!

The BAASH-ROSS DRILLING TYPE BUMPER SUB

THERE'S A LOT OF DIFFERENCE IN BUMPER SUBS—particularly in the internal construction and provision for long sustained operation under the most rugged of modern high speed drilling operations. As its name implies, the Baash-Ross *Drilling Type* Bumper Sub is specially engineered for rough and tough drilling applications . . . specially engineered to *stay on the job* for run after run with minimum maintenance and attention.

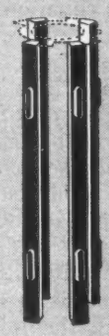
Moreover, its simple design and construction eliminates complicated mechanisms and assures quick, direct operation whenever its protection is needed. It can be used to strike both *DOWN* and *UP* blows with equal effectiveness!

AMPLE RADIAL DRIVE



Here's a vertical cross-section view of the Baash-Ross Drilling Type Bumper Sub. Note the ample number of drive keys equally spaced around the circumference of the tool . . . plenty of keys to transmit all the torque the drill string can handle—and to withstand heavy vibration and rough drilling.

. . . PLUS LARGE VERTICAL SURFACE



Coupled with the ample number of radial drive keys is the extra long vertical length of each drive key, as shown in the accompanying illustration. Not only are there plenty of drive keys spaced radially around the tool, but each key is unusually long so as to provide more than enough contact area for all types of drilling loads. Because torque loads are distributed over a greater surface, wear and abrasion are minimized and maintenance is reduced to a minimum.

Replaceable Bronze Inserts LENGTHEN LIFE

In addition to the unusually large drive surface provided by the ample number of radial drive keys and their long vertical length, here's another important Baash-Ross feature . . . each drive key is so designed that the drive surface can be completely renewed by simply replacing removable bronze inserts—a quick and easy operation.

These bronze inserts not only provide the longer life of bronze against steel contact, but being softer than steel they take whatever wear does occur. Thus, by simply replacing the bronze inserts at periodic intervals, the Drilling Type Bumper Sub is easily maintained at peak operating efficiency throughout many thousands of feet of heavy-duty drilling service.

Easy to Use—And Many Uses!

- The Baash-Ross Bumper Sub will strike either a down or up blow to loosen stuck pipe, reamers or bit. Down blows are struck by dropping the drill string straight down, while up blows are struck by "springing" the drill string when the Sub is partly open, thus striking a sharp blow on the up stroke. Both types of blows are easy to strike and their intensity can be readily controlled as desired.
- The Drilling Type Bumper Sub can be placed wherever desired in the string—above bit, reamer or drill collars. Many operators also use it to provide a "free joint" in the drill string between tension and compression zones, thus assuring more accurate weight control.
- In addition, this Bumper Sub can also be used in any type of fishing operation, further increasing its all-around utility!

PACKED OFF FOR HIGH PRESSURE CIRCULATION

Still another important Baash-Ross feature is the high-pressure packing unit between mandrel and sleeve that permits very high circulation pressures to be maintained through the Bumper Sub without leakage. Whenever necessary, the packing can be easily inspected, tested and replaced right on the rig.

Also, note the large circulation passage through the tool that not only permits full volume circulation to the bit, but also permits running wire line tools through the Bumper Sub without risk of hanging up.

From every angle, this tool is designed and built to meet the vital requirements of *sustained operation* in modern drill strings!

AVAILABLE IN ALL POPULAR SIZES

The Baash-Ross Drilling Type Bumper Sub is available in a complete range of sizes to fit Regular, Full Hole and Internal Flush drill strings from 3½" through 6⅝"—for both Left and Right Hand strings. Standard stroke is 16", but other strokes can be supplied on order.

Write direct for full details—or see your nearest Baash-Ross representative!

(Leased in U.S.A.—Sold for Export only)

Counterbalance Requirements

KENNETH N. MILLS*

EXCLUSIVE

THE problem of estimating counterbalance requirements is one of the most important phases of applying pumping units to oil wells. Its importance is equal to that of estimating the peak well load, because these two values determine the magnitude of the peak torque load, and therefore, the size of pumping unit required.

If the estimated value of peak well load is right and the estimated counterbalance requirement is high, the actual peak torque will be excessive, and the speed reducer may be overloaded. Conversely, errors in these estimates can result in the selection of equipment with excessive capacity, and increase the cost of pumping equipment.

The common approach to the problem of estimating counterbalance requirements is to assume that a constant percentage of the peak well load can be counterbalanced. The commonly assumed values of counterbalance is 60 per cent of the calculated peak well load. The accuracy of this assumption has been checked* and found far from ideal. At the time of this investigation, however, it represented the best known theoretical approach.

As the purpose of a counterbalance on a pumping unit is to equalize the amount of work done on the up and down halves of the pumping stroke cycle, the amount of counterbalance required can be calculated from a dynamometer card. Referring to the dynamometer card shown in Fig. 1, the amount of counterbalance required to properly balance a pumping unit in this case would be:

$$CB = \frac{W_1 + W_2}{2}$$

where:

CB = Counterbalance, lb.
W_1 = Upstroke load at mid-stroke, lb.
W_2 = Down stroke load at mid-stroke, lb.

The theoretical expression for these two well loads are:

$$W_1 = W_0 + W_r + W_rA + F$$
$$W_2 = W_r - W_rA - F - C$$

where:

W_0 = Weight of oil on net plunger area, lb.
W_r = Weight of rods, lb.
$A = \frac{LN^2}{70{,}500}$
L = Stroke, in.
N = Strokes per min.
F = Friction force, lb.
C = Cross sectional area of sucker rod times fluid pressure at bottom of hole due to fluid column in tubing, lb.

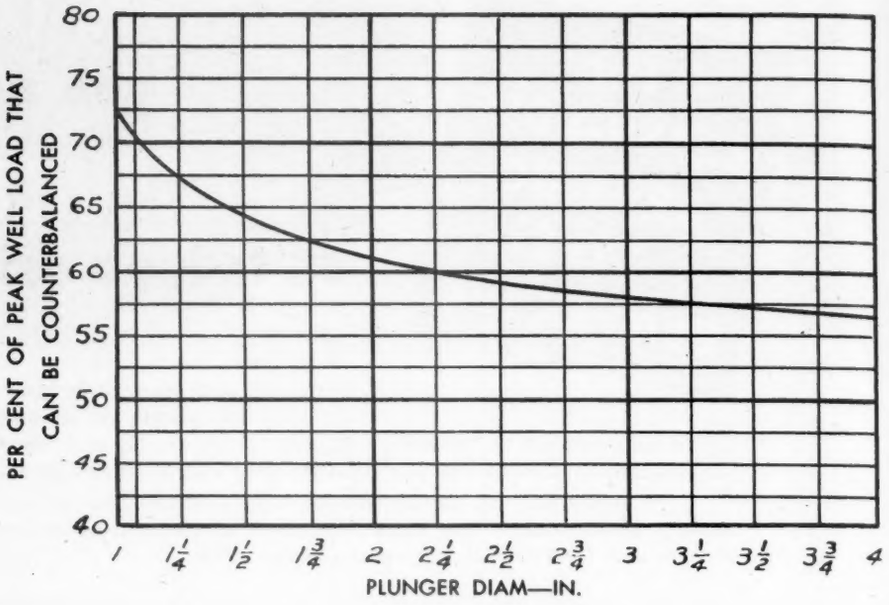
In these equations it is assumed that the friction losses are equal on the up and down portions of the stroke cycle. This is a reasonable assumption, because the sucker rod velocities are equal on the two halves of the pumping stroke cycle, and the friction losses should be proportional to the velocity. The effect of fluid pressure on the end of the lower rod is considered in the expression for the down load only, because the only fluid displacement produced by the sucker rods occur on this half of the stroke cycle.

On the left half of the stroke cycle the rods do not displace fluid, because they travel with the fluid. On the drop half of the stroke cycle, the sucker rods act as a plunger in a plunger type pump and displace a volume of oil equal to the cross sectional area of the rod multiplied by the stroke length.

Substituting the expressions for W_1 and W_2 in the equation for counterbalance we have:

$$CB = \frac{W_0 + W_r + W_rA + F + W_r - W_rA - F - C}{2}$$

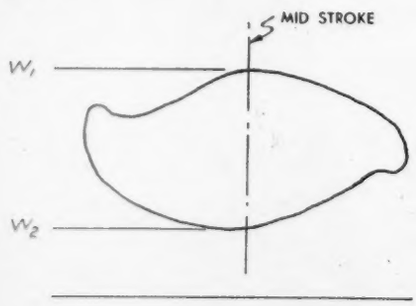
FIG. 2



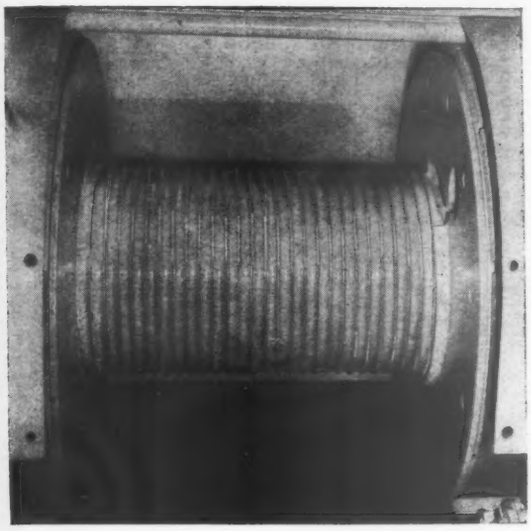
*Assistant Chief Mechanical Engineer, Emsco Derrick & Equipment Company, Houston, Texas.

*Report on Well Load Formulas, by Kenneth N. Mills, A.P.I. Production Bulletin, Volume 24, 1943.

FIG. 1



S-A-V-E



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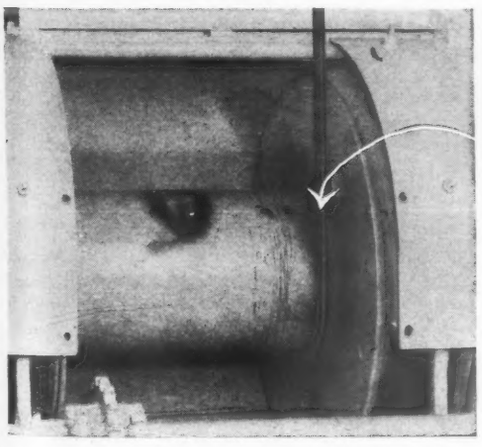

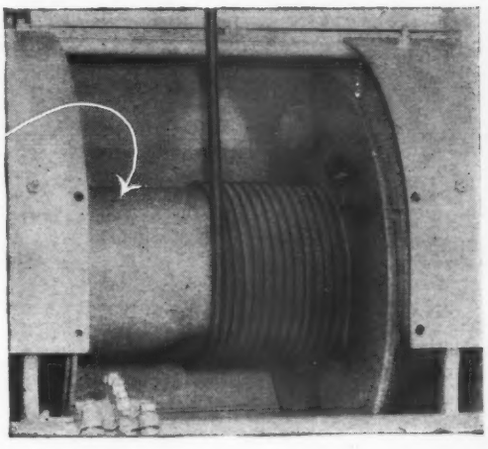

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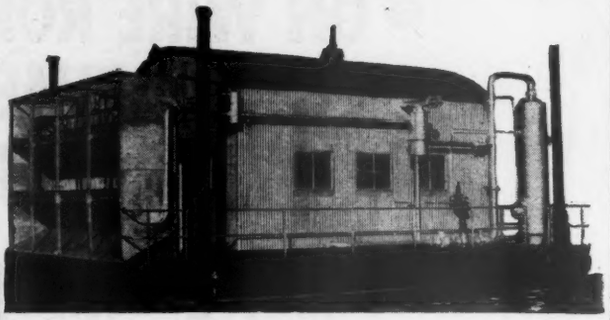

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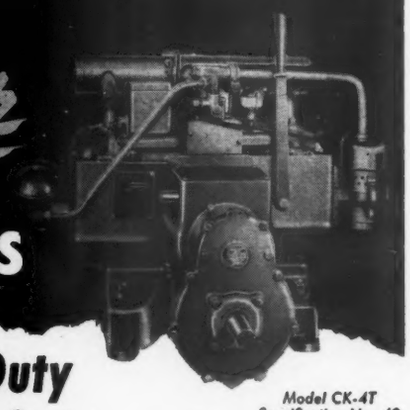

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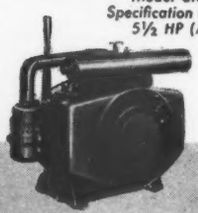

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$$CB = \frac{W_0 - C}{2} + W_r$$

To place this expression for counterbalance in a simplified form, it can be expressed as a percentage of peak well load provided practical operating conditions are assumed. In establishing these percentage values, it should be realized that small plungers may be used in deep wells and will probably be pumped at slow speeds. As the plunger diameter increases, it is probable that the stroke length will decrease and the pumping speed will increase. A graphical presentation of counterbalance expressed as a percentage of peak load based on assumed operating conditions is shown in Fig. 2.

In this chart it should be noted that the percentage of the peak well load that can be counterbalanced decreases as the plunger size increases. This is reasonable, because the ratio of fluid load to rod load increases as the plunger diam is increased. It should also be noted that about 60 per cent of the peak load may be counterbalanced when a 2¼-in. diam plunger is used. This lends credence to this approach to counterbalance determination. This plunger diam was near the average in common use at the time of the aforementioned investigation.

* * *

Mud Schools Begin

To keep pace with expanding Canadian oil development, which currently is reported to have 115 rigs actively operating, The University of Alberta in cooperation with the American Association of Oilwell Drilling Contractors, has initiated a series of mud schools at Edmonton, Alberta.

Designed for roughnecks, derrickmen, tool-pushers and others interested in drilling fluid handling and control, as applied to Canadian operations, the first schools were held May 16 through 27.

Instruction on the function of drilling fluids, standard mud tests, good mud practice in the area, use of chemicals and weighting materials in controlling mud quality, etc., was given by James E. Conway, drilling fluid specialist of the University of Texas, and by members of the staff of the Department of Chemical Engineering, University of Alberta.

A registration and tuition fee of $15.00 per man will be charged for the course and, upon satisfactory completion, each man will be given a certificate showing that a minimum of thirty hours has been completed.

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EXCLUSIVE

Use of Oil Base Mud to Free Stuck Pipe

GEORGE MILLER

WITH prevailing high rig-time costs —$1000 to $3500 a day—fishing can become a very expensive process. The release of stuck pipe, indeed, may cost anything from $10,000 to $100,000 or more, and that doesn't take into account other expenses and inconveniences that are the normal accompaniment of lost operating time. Any implement or system, thus that will speed the freeing of stuck pipe and expedite the resumption of drilling, should be welcomed especially by those operators who are engaged in deep drilling.

This article discusses briefly some of the causes of stuck pipe and the considerations that commend the use of oil-base mud for its release. It also cites a series of case histories with details of the techniques involved and their ultimate effects. It must be noted, however, that the actual experiences recorded here are with one specific oil base mud,* and that all subsequent mention of oil base mud refers to this particular drilling fluid.

Twelve attempts have been made to date with this oil base drilling fluid to loosen stuck drill pipe. Ten of these jobs have been successful. On one of the two failures the stuck pipe, during fishing operations, slid down the hole about 550 ft. This record is quite impressive as in almost every case many hours of spotting crude oil, working the pipe, and miscellaneous methods of jarring, preceded the use of the oil base mud. In some cases the latter was used only as a last resort prior to the intended use of fishing tools.

The cost of trying the proper type of oil base mud in such a case is extremely low, as this mud can be salvaged, if desired, and stored for use for other stuck pipe jobs; or, for the main purpose for which oil base mud is intended, that is, for drilling into the oil zone for a maximum productive completion.

Why Pipe Gets Stuck

There are various reasons for drill pipe becoming stuck in a well bore. A common cause is mud cake from water base mud. Heaving shale, hole caving, settled weighting material, drill cuttings, or small objects dropped into the hole from the rig floor are other frequent causes. If one or more of the above conditions are the cause of stuck pipe in a given case; if circulation can be maintained; and if quantities of crude oil and emulsion-type mud have not been used in the initial attempts to remedy the situation, it has been found that stuck drill pipe may be freed by the circulation of oil base drilling fluid.

The theory explaining the effectiveness of oil base mud in cases of this kind is quite simple. The calcium hydroxide in the oil base mud reacts with the clay to flocculate the latter, thus changing the colloidal character of the clay mud cake and its tendency to bond with the wall of the hole. As sections of the cake collapse or "slough off," the oil base fluid penetrates underneath the surface of the exposed area, thus loosening it further and replacing the clay mud cake with a much thinner oil base cake.

*Black Magic.

The Author

George Miller, president and general manager of Oil Base, Inc., is a graduate of University of Southern California in general engineering, and of the University of Michigan in mechanical engineering. He is a licensed petroleum engineer in the state of California. For two years after graduation he was a trainee with Union Oil Company of California, then he accepted a post as junior field engineer and later drilling engineer with Shell Oil Company. He was later a research chemist and service engineer for Baroid Sales. He invented and patented Black Magic, and in 1942 organized Oil Base Drilling Fluids Company to exploit the new product. During the war he was a Lieutenant in the Submarine Corps. In 1946, Oil Base Drilling Fluids Company was incorporated and became Oil Base, Inc.

A Penetrating Medium

In more difficult cases of stuck drill pipe, a 20 to 30 bbl "pill' of diesel oil mixed with one drum of a detergent-base chemical is spotted in the oil base fluid and circulated slowly by the bit or allowed to stand opposite the stuck section of the hole for short periods of time. Diesel oil by itself, or in conjunction with the chemical has no plastering properties and is used as a penetrating medium.

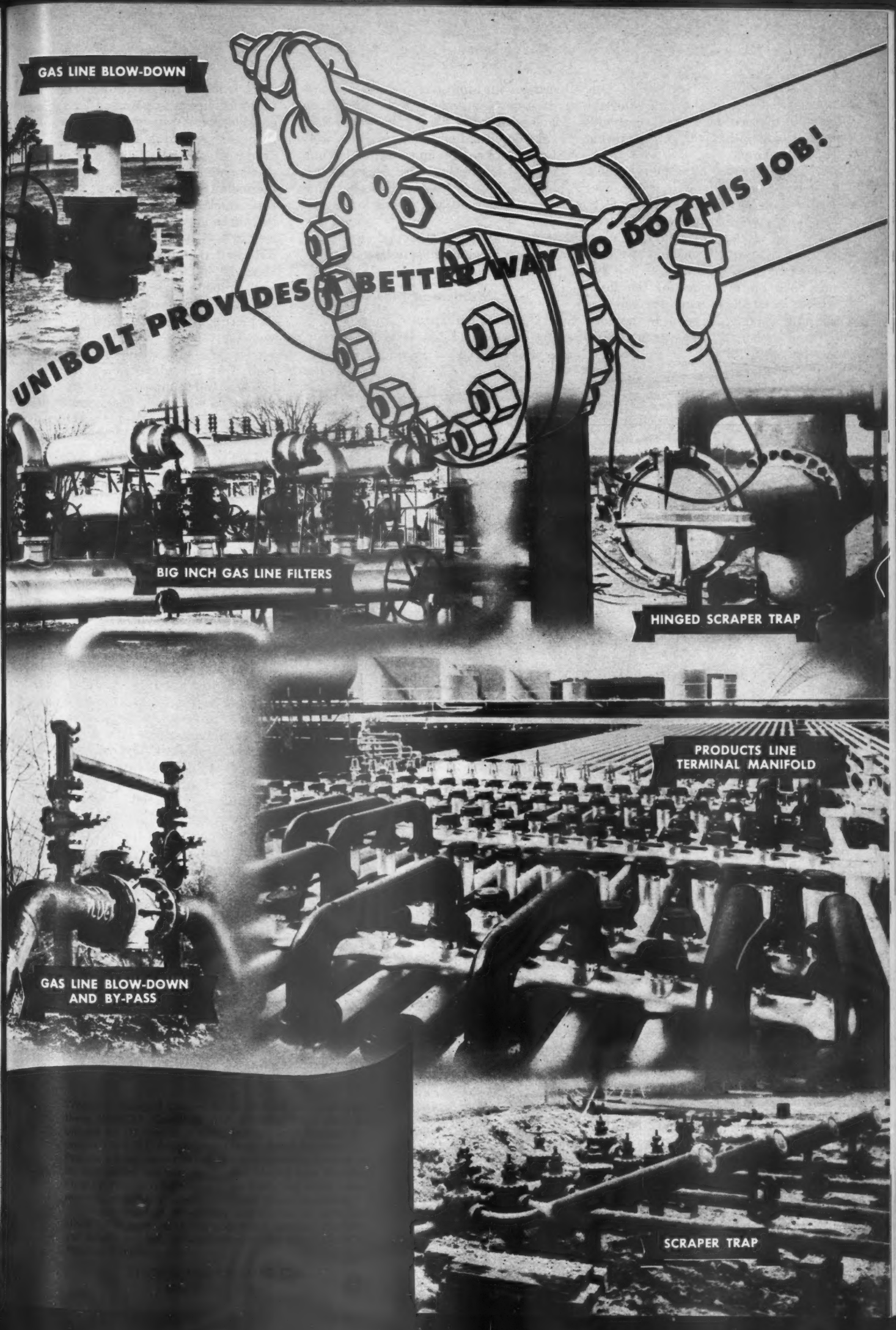
The detergent nature of the chemical increases the speed and distance of penetration of the diesel oil into the clay mud cake or the formation surrounding the desired section of the well bore. This happens because a clay mud cake will allow the passage of water; likewise it will permit the passage of some diesel oil. As the oil displaces some of the free water from the clay mud cake, the plasticity of the clay cake diminishes as the hydrated clay particles become surrounded by a film of oil. The overall effect is a softening of the clay mud cake, depending upon the length of time of diesel oil contact.

Diesel oil is used as a "pill" in the oil base mud because, if channeling occurs (the chemical in the diesel oil tends to prevent it) this oil base mud is only diluted; whereas, if crude oil were substituted for the diesel oil, it would tend to disintegrate this oil base fluid, ruin its gel strength and plastering properties, and allow any weighting material present to settle out.

Increasing Hole Diameter

In some cases, it is desirable to cause the walls of the well bore to collapse, thus breaking the hold on the pipe and creating a larger hole around the stuck section of the pipe. This is done by spotting a diesel oil-chemical pill opposite the desired section of the well bore for a short time, and then resuming circulation with oil base mud.

Due to the high temperature thixotropic properties of this oil base mud. which are aided by the chemical in the diesel oil pill, the cavings from the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purposely collapsed section of hole are carried out of the well, and the sides of the new hole are coated with a thin cake, that tends to prevent further caving.

After the pipe is free, the next step is to come out of the hole, check over the drill string, and then go back in the hole and circulate until the oil base mud is clean of sloughing clay, mud cake, and drill cuttings. By then it has deposited its own thin impervious cake on the sides of the hole, which, in effect, is much the same as running a string of casing in the hole. This oil base mud has plastering properties with almost zero fluid loss and does not penetrate into the formation unless crevices exist. The paper-thin cake deposited on the sides of the well bore is not soluble in water. If it is not desired to continue drilling with the oil base mud, it may be displaced with water base mud and stored for future use.

A summary of all actual cases ever attempted with this oil base mud to date is as follows:

Kettleman Hills

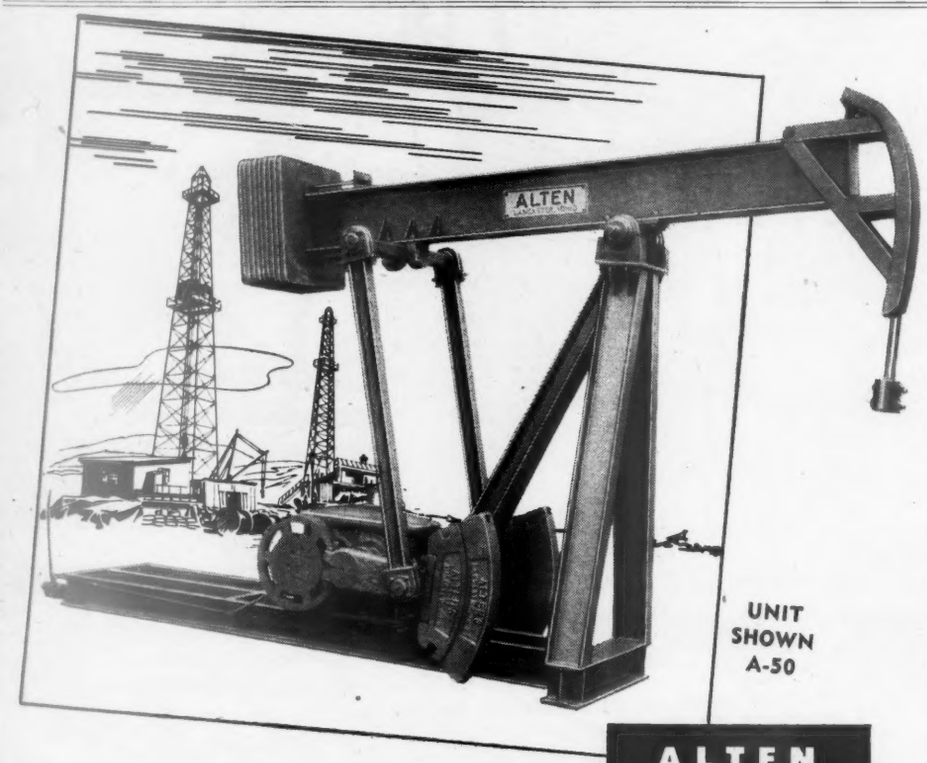
Operator had spent 8 months drilling down to 11,333 ft and had been stuck twice on the way down. The first time the pipe was loosened by taking considerable strain on it; the second time, the use of a large amount of crude oil proved effective. A protective string of casing was run shortly thereafter. The third time the drill pipe stuck was while pulling up off bottom to make a connection. Circulation was still possible. Calculations indicated that the pipe was stuck at about 10,360 ft. Following the sticking of the pipe, a period of about 34 days elapsed in which every known means of jarring pulling on the pipe, back scuttling, spotting of crude oil, etc. was tried without success. Oil base mud was mixed in about 80 bbl batches and pumped down the hole displacing the water base mud. After circulation was established with the oil base mud, a pill of 45 bbl of diesel oil was spotted near bottom and held there for about one hour. This pill was then slowly moved up the open hole in 15 min intermittent intervals. At the end of each 15 min of the slowest pumping, the pumps were stopped for one hour and then pumped again for another 15 min until the diesel oil was calculated to be up inside the casing.

Full circulation was then begun, and considerable mud cake came out of the hole for about 2 hr. Some of the mud cake was of such size that it seemed almost impossible for it to be carried up through the annular space between the casing and the drill pipe. Much of this mud cake was so hard that a single blow with a hammer would not break it. The drill pipe was worked steadily during the circulation period. At the end of about 10 hr, a second pill of diesel oil was spotted as before, but this time somewhat less mud cake appeared in the flow ditch.

Circulation was again commenced in conjunction with working the pipe. After five round trips of the mud and the spotting of the last pill of diesel oil, the drill pipe came loose and was pulled from the well. Some distance up from the bit, on the drill pipe, were several doughnut shaped sections of very hard clay-water mud cake from one to four ft in length and about hole size in diameter. This mud cake appeared to be "baked" onto the drill pipe and had to be removed with a hammer.

McKittrick Field

Operator had a drilling program for about 12 shallow wells in this field. The total depth of these wells averaged about 2000 ft. At about 1800 ft in this area a rather steep-dipping, hydrous-swelling shale formation exists, which, on the first two wells, caused considerable trouble in



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running the drill pipe in and out of the hole after this depth had been reached. On the third well, at slightly deeper than 1800 ft this shale "grabbed" the pipe and no amount of pulling, attempted rotation, etc. seemed to help. Circulation was not lost.

At this point it was decided to try circulating oil base mud. The latter was mixed, and the water base mud in the hole was displaced. No oil "pills" were spotted. After circulating the oil base fluid around the system about 5 times and disgorging considerable shale and mud cake, the drill pipe came loose and was brought out of the hole. In the subsequent wells drilled in this program, a standard procedure of changing to oil base drilling fluid at about 1800 ft was followed, and no further sticking or operating difficulties were experienced.

Newhall-Portrero

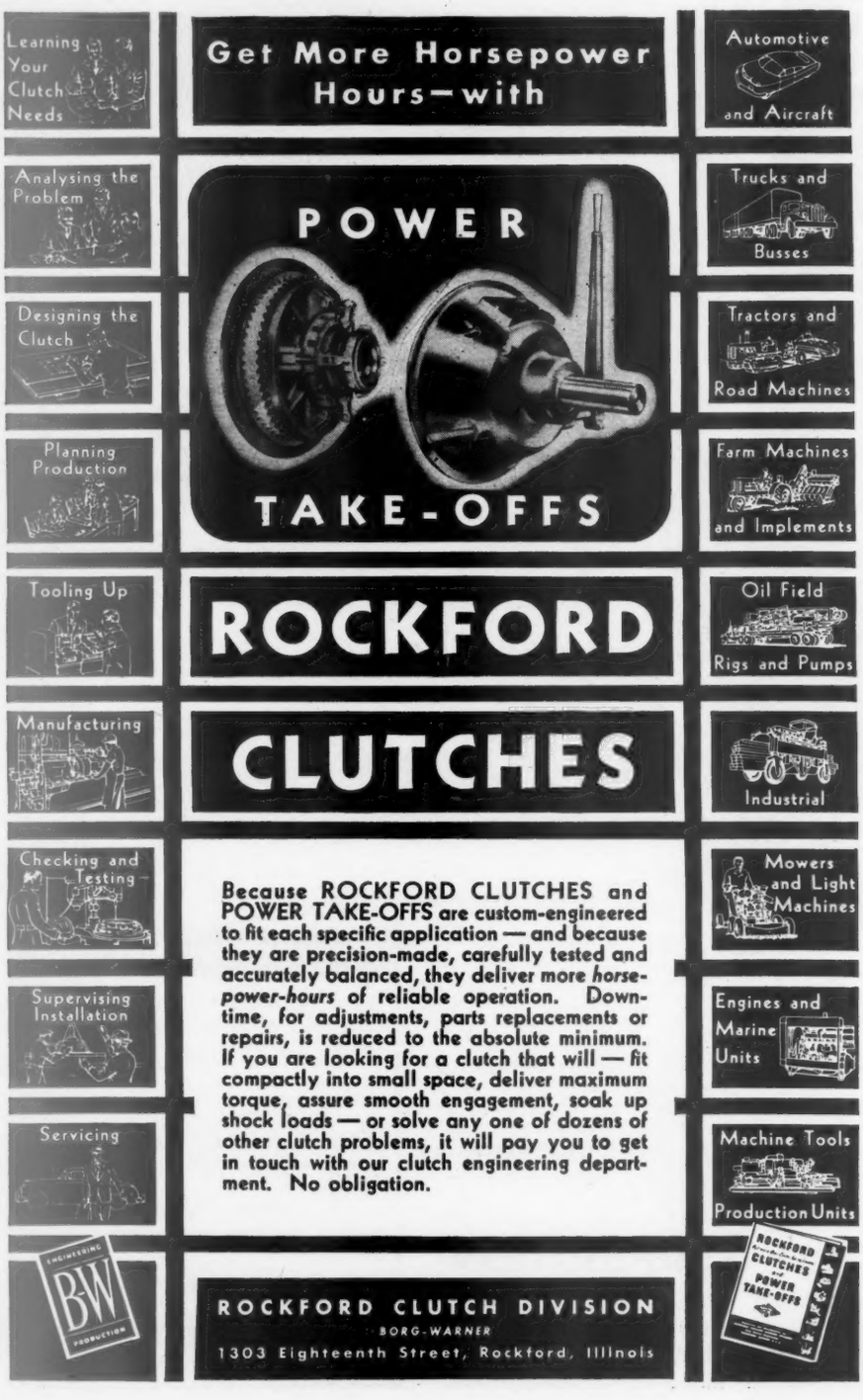
This well was being drilled and cored with a starch mud in the hole. The drill pipe stuck while pulling up off bottom to make a round trip. The mud was reported to have a 1.0 cc. API filtrate loss. The depth of the hole was 10,298 ft with 7 in. casing set at 9875 ft. The 3½-in. drill pipe was stuck at 10,286 ft. Before trying oil base mud the operator pulled on the pipe intermittently and tried to rotate, with no results. The stuck drill pipe was worked for about 24 hr while maintaining circulation without success. Next 50 bbl of 80 lb per cu ft oil base mud was mixed and spotted in the open hole below and in the lower part of the casing.

After taking a strain on the drill pipe, the operator began rocking the mud in and out of the drill pipe and occasionally working it. The stuck drill pipe jumped loose after about 5 hr of this treatment. After the pipe was pulled from the hole it was found that large quantities of mud cake and small pieces of shale were embedded around the bit and bit sub, which had evidently caused the pipe to stick. Although the method described was effective, it is not recommended as a normal procedure. Without circulation, the clay mud cake that is removed by the oil base fluid cannot be carried to the top of the hole and removed from the oil base mud via the mud ditch or pits. Plugging of the bit could result, and then circulation would be impossible. Also, pieces of loose shale might tend to become trapped near the bit and aggravate the situation.

Fruitvale Field

An operator in a directional redrill job had milled a window in 8⅝-in. casing at 2908 ft and was drilling ahead at 3600 ft with 7⅝-in. hole. After pulling up the drill pipe 44 ft to take a directional single shot, the pipe was stuck at 3556 ft. The inclination of the hole at that point was 3 deg 30 min. After attempting to work the pipe loose for several hours, the 3½-in. drill pipe was backed off at 2400 ft and a bumper sub run in and screwed onto the fish with drill pipe. The pipe was then worked for 2 hr, but it would not come loose. As the point at which oil base mud was to be placed in the hole was almost reached at the time the pipe was stuck, it was decided to displace the water base mud immediately.

The pipe came loose about an hour after oil base mud returns were noted. The weight of the mud used was 64½ lb per cu ft. The clay water mud previously in the hole weighed 67½ lb per cu ft. The tools in the hole were a 7⅝-in. rock bit with 38-ft by 6-in. OD drill collar and a 7⅝-in. three point reamer on top of the drill collar. When the tools were removed from the hole, the drill collar was found to be balled up with mud cake to the OD of the tools from the bit to the reamer.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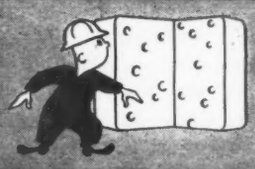
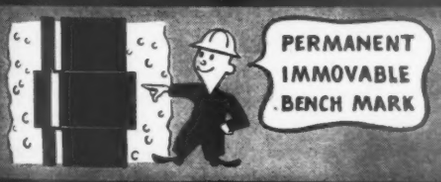
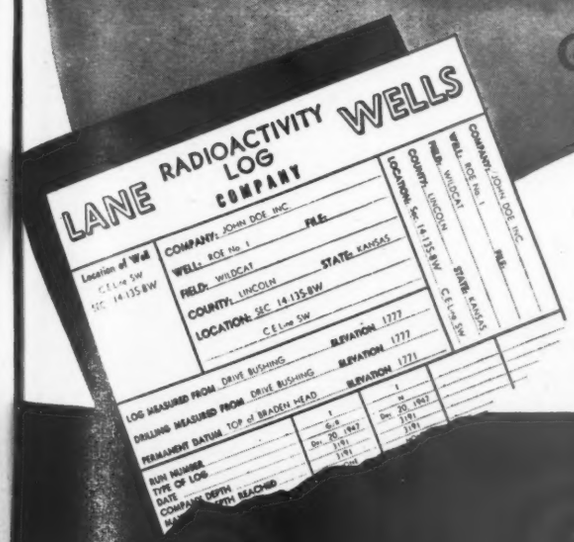


Know where porous zones are



Know just where everything is in relation to casing collars



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Grapevine Area

While coring at 10,350 ft in a wildcat, the core barrel became stuck on bottom. One hundred bbl of 16 gravity API crude oil was spotted near bottom and displaced out of the bit at the rate of 5 cu ft every 15 min. No results were obtained, and none of the oil was recovered. A string shot was then made at 10,122 ft in an attempt to back off the pipe. No results were obtained. Another string shot was run at 10,036 ft also without results. A test was run and indicated that the pipe was free at 8630 ft. This was done approximately 48 hr after the pipe was stuck. Next, a total of 293 bbl of oil base mud was spotted on bottom from the bit to the point in the hole at which the pipe was known to be free. The oil base fluid was displaced from the drill pipe at 10 p.m. and the pipe was loose at 12:01 a.m., or silghtly over 2 hr later. All of the oil base mud used on this job with the exception of a very few bbl at the clay-water, oil base mud interface, was recovered. The oil base mud used at the time weighed 78 lb per cu ft and had an API viscosity of 125 sec.

Grapevine Area

The next stuck pipe job in the same well as above occurred 111 days later. While pulling an 8⅝-in. bit from 15,042 ft the drill pipe was stuck at 15,037 ft. The pipe was stuck at 12:30 p.m. and within 3 hr 100 bbl of 78 lb per cu ft oil base mud had been spotted on bottom. The pipe was worked and came loose at 9:30 p.m. the same day. The water base mud in the hole weighed approximately 88 lb per cu ft, or 10 lb per cu ft more than the oil base mud used.

Portrero Field

Operator had drilled well to 10,125 ft with water base mud and completed it with very negative results. The decision was made to redrill into the production zone by milling a window in the 7-in. casing at 8310-8323 ft and setting a whipstock at 8323 ft. The well was thus started to be redrilled, and water base mud was used as the circulating medium. During routine redrilling operations about 1127 ft below the window in the casing, the drill pipe became stuck. After trying various remedial efforts without success, it was decided to displace the water base mud with oil base and attempt to loosen the stuck drill pipe. Approximately 45 min after circulation was established with oil base mud the drill pipe came loose. After allowing the clay water mud cake, which was being brought out into the ditch in quantity to become cleaned from the oil base mud, routine operations were then carried on and the remaining desired footage of zone was successfully drilled with the latter. No diesel oil "pills" or chemical was used during the loosening process.

Bottom mixing gun being used in mud pit.

Montalvo Field

This well was drilled to 17,696 ft with water base mud and the last several thousand feet with lime starch mud. Before coming out of the hole on a routine trip to change the bit, the mud was raised in weight from 92 to 95 lb per cu ft by use of barytes. After circulating the mud for two round trips the drill pipe was brought out of the hole. No trouble was experienced going back in the hole. An established practice on this well was to stop the inward trip a single off bottom and break circulation to minimize the possibility of plugging the bit or sticking the pipe. This was done, and when the pumps were started, the pressure jumped up to about 3000-3200 psi and a gasket on the master gate leading to the standpipe blew out. While a new gasket was being installed there was no circulation; the drill pipe, however, was moved up and down and rotated continuously. When the gasket changing job was completed, the pumps were started once again, and the mud pressure rose to 4000 psi, stalled the pump engines, and the drill pipe froze immediately. At this time the drill pipe could not be rotated nor moved either up or down. Seven inch casing had been set at 11,877 ft and there was 5819 ft of open hole below the shoe. The drilling fluid in the hole at this time was a lime-starch water base mud weighing approximately 95 lb per cu ft, having a viscosity of about 55-60 seconds, and a water loss of about 4 cc. with a 2/32-in. filter cake (filter test run at atmospheric temperature). By use of a large cement truck and high pressures, circulation was once again established. About 8 hr after the pipe became stuck 45 bbl of crude oil were spotted out of the drill pipe with no results. The next day 71 bbl of crude oil were spotted—no results. The next day 100 bbl of crude oil were again spotted—no results. The next day the lime-starch mud was displaced by an oil-emulsion water base mud, and this mud was circulated for two days while working the pipe—no results. One hundred fifty-six bbl of crude oil were spotted out of the drill pipe the following day—no results. Two days later another 156 bbl of crude oil were spotted—no results. The oil-emulsion mud was then circulated for 5 more days while continual efforts to move the pipe were made—no results.

During drilling operations, just prior to the pipe becoming stuck, the pump pressure was approximately 2000-2200 psi. After the pipe was stuck and with this oil-emulsion mud in the hole, the circulating pressures were about 2600 to 2700 psi. Under similar circumstances the circulating pressure with the lime-starch mud was approximately the same as the previously mentioned normal drilling pressures.

With very little chance for success due to the above-mentioned operations having taken place, oil base mud was next put into the hole and the oil emulsion mud displaced. This was done approximately 12½ days after the pipe became stuck. The oil base fluid was put into the hole in the following manner: 30 bbl of 100 lb per cu ft oil base fluid was pumped into the system first, followed by 30 bbl of diesel oil treated with one drum chemi-

cal to reduce its surface tension, followed by normal oil base mud weighted to 95 lb per cu ft. This oil base mud volume was then circulated around the system slowly. When circulation was broken the pump pressures rose to about 3000 psi and within two minutes dropped down to 1800 to 2000 psi and remained in this range during subsequent pumping operations.

As the oil base mud was circulated, a considerable amount of water base mud cake and large chunks of what appeared to be hydrated lime from the lime-starch mud was discharged into the mud ditch. Due to the short length of the mud ditch and the almost plastic condition of the mixture coming out of the hole, it was necessary to dump the contents of the ditch and to facilitate this operation with a high pressure water hose. Approximately 50 bbl were dumped in this manner. After the mud had become a bit more clean so that it would run in the ditch, it was directed over the two mud shakers which were equipped with 20 mesh screens. These shakers, while operating, handled the mud very well with only infrequent cleaning with a wire brush. For about 10 hr considerable mud cake and little balls of white powder and barytes were separated from the mud by the shaker screens and by shoveling the ditch.

After approximately 15 hr of circulating and with the drill pipe still stuck, a second 30 bbl chemical treated diesel oil "pill" was run into the system behind a "pill" of oil base mud weighing about 105 lb per cu ft. The diesel oil was spotted just outside the drill pipe and allowed to remain there for a period of 30 min. Longer diesel spotting periods were not allowed. When circulation was restarted, an attempt was made to catch the remains of the diesel "pill" and dump it so that the weight of the oil base mud would not be reduced, but it was never found. Approximately two hours after the light part of the mud should have appeared, considerable water base mud cake, etc. be running over the shakers again, ...y this time there was less loose fluffy mud cake and the majority of it was firm and hard. At this time the drill pipe moved up about 2½ ft. Due to the amount of diesel oil added by this time, the weight of the oil base mud had been reduced to about 90 lb per cu ft, so it was raised back to 94 lb per cu ft by use of barytes.

About 20 hr later another "pill" of diesel oil was added in the manner described, and this again increased the flow of mud cake, etc. over the shakers. The oil base mud weight dropped from 94 to 93 lb per cu ft, but within 8 hr had increased to 96 lb per cu ft without any further barytes additions from the surface.

Calculating the size of the hole and the amount of mud in the system, it would have taken almost 170 ft of nearly solid barytes in the hole to be picked up by the oil base mud in order to increase the weight this amount.

Once again a pill of diesel oil was spotted in the system which lowered the weight of the oil base mud to 94½ lb per cu ft. Again in about 6½ hr the weight came up to 96 to 96½ lb per cu ft by picking up weight material from the hole. During all this time the pipe was worked every hour on the hour and a movement of about 15½ ft had been gained since the oil base mud had been put in the hole, but the drill pipe would not come loose. After 6 days of trying to loosen the stuck drill pipe with oil base mud, the operator decided to spot 5000 gal of hydrochloric and hydrofluoric acid out of the drill pipe in hopes this would work on the formation enough to loosen the pipe. This acid was spotted for about 12 hr and surged periodically. No results were obtained by acidizing so the acid was pumped out of the system by reverse circulation. Most of the acid was dumped from the system with very little contamination of the oil base mud.

The next operation was to shoot off the drill pipe, or to allow the drill pipe to be backed off due to explosive force. After considerable difficulty this was accomplished, and the drill pipe was backed off at about 12,972 ft. This much drill pipe was recovered and a cement plug was placed at the top of the fish before the hole was abandoned. Approximately 570 bbl of oil base mud was salvaged, which was later transported to and used in another well being drilled by the same operator. It may be of interest that aside from the fact that unfortunately the oil base fluid was unsuccessful in releasing the stuck drill pipe in this case, it performed perfectly and was being used at depths of greater than 17,650 ft—the high temperatures at this depth having very little effect upon it.

In summation, the oil base mud treatment did allow the drill pipe to be moved up the hole about 15½ ft, whereas no movement was gained with any other type mud used; crude oil spotting, or use of acid.

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Newhall Portrero

This well was drilled to a depth of 9238 ft with a water base mud having a weight of 83 lb per cu ft. No casing was in the hole other than the surface string. The hole had been giving considerable trouble with keyseats and tight places for some time. It was finally decided to put a reamer on the drill string about 3000 ft above the 7⅞-in. rock bit. Very little trouble was experienced going to bottom with the drill pipe and reamer set-up, but upon trying to come out of the hole the pipe would come no further than 6258 ft. It was decided that the reamer was stuck in a keyseat and that the bit was free. The next step was to lower the reamer approximately 100 ft below the keyseat and run a cement bridge below the bit, using 50 sacks of conventional cement. This left about 3000 ft of 83 lb per cu ft water base mud below the bridge. The cement job was satisfactory and the drill pipe was lowered to the bridge and allowed to set on it. The 4½-in. drill pipe was then cut off at 3097 ft. The next step was to open the hole from 11 in. to 12¼ in. down to the reamer and then go back in the hole with an over shot. No trouble was encountered getting over the pipe, but the pipe would not move. After approximately one week of pulling, circulating, and spotting of crude oil, oil base mud was put in the hole. This weighed 62 lb per cu ft and had a viscosity of 120 sec API, which gave a differential weight of 21 lb per cu ft between the oil base and the water base mud. After the system was changed over, and two circulations of the oil base volume made (about 4 hr), the drill pipe came loose. The oil base mud became loaded with cuttings, cavings, and water base mud cake. After some time being spent cleaning the debris from the oil base mud by shaker screens and ditch shoveling, the mud weight was raised to 70 lb per cu ft and the unstuck drill string brought out of the hole. No chemical or diesel oil was used in the freeing of this drill pipe.

Seal Beach

Operator had finished taking a core at 9790 ft with starch mud as the circulating fluid and was coming out of the hole. At 6628 ft the drill pipe became stuck. A test indicated that the pipe was free at 6450 ft and tight at 6460 ft. Next, 150 bbl of crude oil were pumped out of the bit at 6628 ft and the drill pipe worked for 17 hr without results. A vibration shot was

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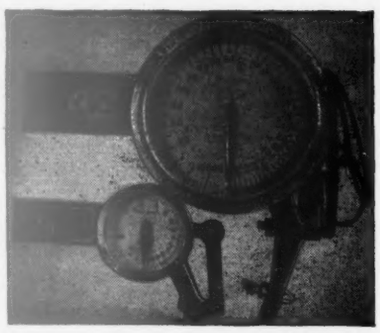

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run in and set off at 6450-6490 ft with the entire weight on the drill string but no results were obtained. At this point the water base mud was displaced with oil base fluid in an effort to free the stuck drill pipe. The oil base mud was circulated for 28 hr while the pipe was being worked but no results were accomplished. A diesel oil "pill," either with or without chemical was not allowed to be used. It was then decided to conduct a fishing job with the oil base fluid in the hole. Accordingly, a string shot was set off at 6440 ft and the drill pipe backed off at 6434 ft, leaving a single joint of drill pipe, a bumper sub, two drill collars, and the core barrel in the hole. After cleaning out to the top of the fish, a knuckle joint with a wall hook was run in order to center the fish in the hole. A socket and jars were then used to take hold of and jar the fish, but no results were obtained. Next, an 8⅝-in. wash pipe was used to wash over the fish from 6434 to 6509 ft. After this a socket was run, but the top of the fish could not be located. The hole was then cleaned out to 6520 ft, but location of the fish was not discovered. After cleaning the hole out to 6534 ft an electric log was run which located the top of the fish at 6438 ft. A knuckle joint and wall hook was then successful in bringing the top of the fish out to the center of the hole. Again a socket was run, but the fish could not be located. Next, a knuckle joint and safety joint with single below collar was run in the hole and successfully screwed into the fish. Four hours of jarring produced no results. The tools were then unscrewed from the top of the fish at 6436 ft and again an 8⅝-in. wash pipe run. The fish was then washed over to 6619 ft, whereupon the fish came loose and moved down the hole. A 10⅝-in. bit was then run, and the hole cleaned out to 6619 ft. At this point the oil base mud was displaced with water base mud, and a socket again run in the hole but without results. It was then discovered that the hole was sidetracked at 6574 ft. Next a hole opener was used to clean out from 6619 to 6988 ft and a socket and jars run later which successfully caught hold of the fish. With this attempt, the fish finally jarred loose at 5988 ft and the whole fish was recovered. Even though the fish did not come loose while being jarred with oil base mud in the hole, it was the stated opinion of the drilling foreman on the job that without its use in the hole, they could not have washed down over the fish with their washover pipe.

Fruitvale Field

Operator was using oil base mud on a routine well completion and due to running sand the drill pipe became stuck, much to the amazement of the drilling crew—since oil base mud was in the hole. The facts were as follows:

Since the circulating system was running short of a sufficient volume of oil base mud, and in order to save time in mixing additional oil base mud, a considerable amount of diesel oil was added to the system in order to "stretch" the volume. So much oil was added that the weight of the mud was appreciably lowered, and the plastering properties of the oil base mud seriously affected. This allowed the sand in the oil zone to run, which stuck the drill pipe. Upon calling a service engineer, the situation was quickly diagnosed, and additional oil base mud added to correct the diluted condition. The system was then circulated for 1½ round trips of the mud and the drill pipe came loose. The operator then continued drilling and completed the well in the normal manner with no further difficulty.

Church Buttes Field

Operator had set 7-in. casing at approximately 12,870 ft and cemented it. Due to difficulties, a rather large amount of cement was left inside of the casing. Using water base mud, 2⅞-in. drill pipe, and a 6-in. rock bit, most of the cement had been drilled. Driller started a routine round trip to come out of the hole, put on a new bit, go back to bottom, drill the plug, make the test, and change over to oil base mud. On the way out of the hole, the drill pipe became stuck at about 10,000 ft. The drill pipe would come up no further but could be worked down. Whatever was sticking the drill pipe produced an effect like a ratchet—the pipe could only be worked in one direction—down. After working the pipe to bottom the operation was then at a standstill—it could be neither raised or lowered. No amount of circulating or working of the pipe seemed to do the slightest bit of good. At this point the operator decided to displace the water base mud with oil base fluid, figuring that although this was about three days before the scheduled routine changeover, a sooner displacement might alleviate his difficulty. After circulating the oil base mud around the system for two round trips, the drill pipe became absolutely free and was brought out of the hole. During circulation it was noticed that a small quantity of cement fragments were brought up out of the hole by the oil base mud, and it was assumed that these fragments had stuck the pipe. The remainder of the desired footage was made using oil base mud as the circulating fluid, and diamond coring.

* * *

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Reservoir Studies Aided by Data and Mathematics

WILLIAM HURST*

THE developments in reservoir mechanics have been so rapid during the past two decades that what were once believed to be intangibles and unknown factors in oil field performance can now be fitted into a logic of mathematical deduction, which has come to be an important phase of the industry, and is known as reservoir engineering. The contributions of both engineers and research in this field have been noteworthy in adding to our fund of knowledge. It should not be overlooked in our everyday activity and interest in immediate problems, however, that the work and development of physicists and mathematicians of the nineteenth and early part of the twentieth centuries have set the foundation upon which we have built. To mention a few, Darcy, Basset, Kelvin, Gibbs, Slichter, King, Lamb, and Heaviside are names that will always have a place in the annals of petroleum technology.

Early Scientific Works

To discuss briefly the contribution of some of these men: It is known that the early work of Darcy is contained in Darcy's law, and, although formulated in several different ways, it still serves as the criterion for expressing the rate of flow of fluids through porous media. The earliest reference to the solution of an infinite array of wells in steady state, with which this writer is familiar, is contained in a tract published in 1888, entitled "Treatise on Hydrodynamics," by A. B. Basset. It is of historical significance that Basset was a barrister-at-law in London and that his interest in mathematics was essentially an intellectual attainment. This method today is applied to the interpretation of five-spot and seven-spot floods in secondary recovery.

The continuous point source of heat transfer, developed by Lord Kelvin, forms the basis of much of our understanding of flow conditions in producing wells. The phase law and free energy relationships of Gibbs are important considerations in all plant designs, and have added to our knowledge of retrograde loss taking place in condensate reservoirs. Slichter, in the U. S. Geological Survey of 1898, showed the first application of steady state formulae in interpreting artesian flow in an aquifer. Heaviside's engineering intuition led him to develop a new branch of mathematics that lends itself appropriately to many flow problems encountered in reservoirs.

Present day contributions in reservoir mechanics have been treated in several reviews on the subject, and therefore to enter into a discussion of this phase would be covering ground handled aptly by the reviewers. As little or no mention has been made of the historical importance of our predecessors, however, it is hoped that the introductory remarks made here will help complete the pattern of the progress made to date.

Due to the combined contributions of present-day development with the work of a past era, we are now witnessing a break-down of the imponderables with which we were once confronted in the oil business. To illustrate this point: In the not too far distant past, it was considered that the nonuniformity of a sand limited deductions that could be made with regard to reservoir performance. The concerted effort made in the industry has invalidated this contention, which is evidenced by the publications presented within the last few years. It has been shown that the application of the permeability profile, treated as a probability frequency, permits one to employ each permeability increment in a uniform medium, to reproduce the composite effect of all permeability variations. This concept has received extensive application in secondary recovery and gas cycling projects, and the reported results show favorable agreement with actual field performance.

Significant Applications

Reservoir engineering is now an important phase of the petroleum industry. Both reservoir and production data can be employed to determine the amount of oil initially in place. Application of these data can establish the extent of solution gas or water drive on a field, the optimum method of operation, and the probable ultimate production of hydrocarbon products. This gives management an inventory of the reserves in sight, and the optimum rate of recovery.

Such information may be employed in several important ways: It can be the basis for the potential sale or purchase value of an oil or gas property, or the establishment of credit for the negotiation of a loan for the further development of the property, or for use in other investments. It offers a basis for establishing one's equity in unitization programs, and of equal importance, it determines the extent of development that has taken place.

Adequate Data Needed

To undertake an engineering study, it is necessary to have reservoir and production data. An engineer is sometimes limited in forecasting the performance of a reservoir due to the inadequacy of the existing data. It is felt that this situation can be rectified where such inadequacies are known to exist.

Before leaving this section, we should consider the reservoir engineer who is called on to cope with these problems. It is usually found that his technical level and educational background is more advanced than the average engineer. This is not unexpected, because the type of problems he is asked to solve, and the original thought that must be given to all reservoir studies, necessitate these attributes. It follows, therefore, that the training of young reservoir engineers is necessarily long and sometimes arduous, but where such men show merit their efforts cannot be overlooked. The stakes in sight are too great to do otherwise.

Reservoir Data

The status of acquiring core, electrical, and radioactivity logs on newly completed or reworked wells is relatively satisfactory. The use of mud-

*Consulting Engineer, Houston, Texas.

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logging and drill-cutting analyses offers a further means for obtaining a graphic record of the formations penetrated. The importance of such services are realized by the operators, including engineers and geologists, and usually are stipulated in the drilling budget. The status of obtaining production data after the wells are drilled is not satisfactory in some instances. There is a tendency to believe that once a well is completed, producing, and bringing in revenue, to interrupt this procedure to obtain flow tests, bottom-hole pressures, etc., is unnecessary.

To those who may subscribe to this belief, it should be pointed out that such data provide a "yard-stick" measurement of what is happening in the reservoir and to the well, and to overlook the value of these measurements may one day seriously curtail the production of revenue. There is no set formula for determining in advance just how much production data are needed in a field. This should be decided by the reservoir and field engineers, who can lay out a program to acquire such data, and set up a budget to take care of all contingencies.

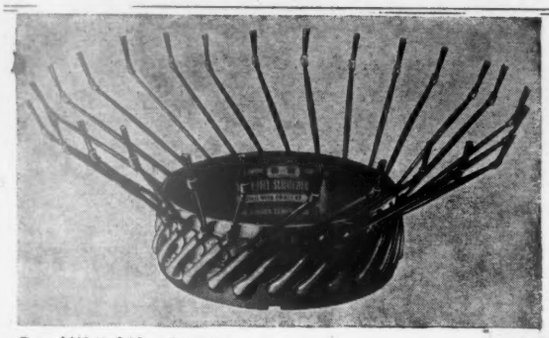
There is often a need for more core data. This is particularly true in areas where difficulty encountered with electrical and radioactivity logs makes cross-interpretation with core data necessary. It is sometimes impossible to obtain good core recovery by standard practices. The use of diamond core bits might remedy this situation.

In the past few years the reader has had occasion to observe the development of the capillarity, the restored state, and the electrical resistivity log methods for establishing the connate-water saturation in the interstices of porous pay formations. The first two methods employ the analysis of cores in the laboratory to establish this parameter. The latter, however, is determined from the electrical resistivity log and indicates this value in place, provided that the formation resistivity factor is known. The determination of the formation resistivity factor is also established from cores. In the Gulf Coast fields, this factor has been fairly well correlated with permeability and porosity. There are many areas now being developed, however, where little or no information is available on formation resistivity factors. Both well logging companies and core laboratories can make such studies, and the importance of the electrical resistivity method suggests that more information be obtained.

Many readers are familiar with the nature of production data required in field operations, but to give emphasis to the importance of obtaining such information, a brief resume of these data is included.

In the early stages of development it is essential to obtain the initial static bottom-hole presure of the first well drilled. There may be extenuating circumstances that prevent the immediate establishment of this pressure after a well is completed, but provision should be made to shut the well in for a sufficient period to obtain equilibrium and make a test. In those fields where initial pressures have not been measured, it is possible to calculate this value from a correlation with nearby fields, but this method is not as accurate as the use of a bottom-hole pressure gauge.

In obtaining the history of the decline in reservoir pressure static bottom-hole pressure surveys are made in the field. Either all wells are tested in a survey, or a designated number of "key" wells. The choice of plan rests with the operators and their engineers, but a sufficient number of wells should be included to offer control in reproducing an isobaric pressure plat of the field. In an undersaturated reservoir that shows a rapid decline of reservoir pressure, quarterly surveys may be re-



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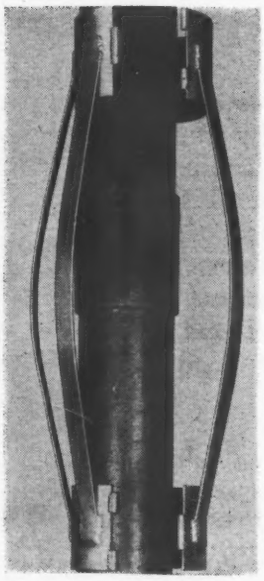

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API Reports 90-Year Achievements

The American petroleum industry has drilled enough wells in the past 90 years to make total drilling footage equivalent to 60 holes right through the center of the earth, the American Petroleum Institute reports. Since its beginning in Titusville, Pennsylvania, in 1859, the oil industry has drilled more than 1,250,000 wells in the United States alone, three-fourths of these in the past 30 years.

Currently the average oil well in this country is about 3000 ft deep. Using 2000 ft for the 90 year average, mathematics show that the generations of oil men have compiled a total drilling footage in excess of two billion 500 million feet.

quired, whereas, in a strong water drive reservoir that shows only a small change of pressure, yearly surveys may be sufficient.

To undertake a comprehensive study of reservoir behavior, representative samples of oil and gas are analyzed in the laboratory for the pressure-volume-temperature relationships of the fluids in the reservoir. The purpose of the analysis is to determine the expansion of the oil and its liberated gas as it occurs with lowered reservoir pressure. The sample used in the analysis is usually obtained by a sampler lowered on a steel line through a lubricator on the tubing. Such a sample may be prepared in the laboratory, however, by recombining samples of oil and gas collected at the separator. Both methods serve the purpose, although some may prefer one to the other. Should the formation show considerable structural relief, it may also be desirable to obtain PVT analyses on samples from wells completed down-structure. The data so acquired have an important application in material balance studies in the determination of reservoir performance.

In gas condensate fields, recombined surface samples of condensate and gas from the separator are also analyzed in the PVT laboratory for the retrograde loss that will occur with lowered reservoir pressure. There are services available that utilize field units for analyzing a continuous "split-stream" from the well to determine these losses. The results established by these methods indicate the feasibility of the property for gas cycling, however, there are other factors that must also be considered in the undertaking of such a project.

Production Rate Measurements

The importance of flow tests is not only to observe the condition of a well, and any remedial rework that may be necessary, but also to acquire information that has an important bearing on the formation conditions surrounding the well. The most satisfactory test is to obtain a complete record of the bottom-hole pressure with the well flowing on different size chokes, followed by a period of shut-in to establish the static bottom-hole pressure. Including the bottom-hole pressure history for the time of flow and build-up, it is also desirable to take continuous tubing and casing readings with a test gauge. The production of gas, oil, and water may be measured at the lease separator and tank battery, or by a small separator unit on a trailer that can be tied into the well. Such units usually have a recording meter for the oil. This is often more accurate than gauging in a stock tank.

Conclusion

The data described are very important in facilitating an understanding of reservoir performance. It is an established practice of many operators to obtain such information in the field, and it is hoped that the thoughts expressed here may provide an incentive for other operators to adopt a similar program. It should not be concluded, however, that a field is unsuited for study because such information was not obtained in the past. It is never too late to begin acquiring such data, and it is often surprising how much can be done with the data at hand.

In concluding this article, it is appropriate to offer a word about the future in a vein comparable to the introductory remarks about the contributions of the past. It is true that there are still problems to be solved in reservoir mechanics, but there are no insurmountable barriers that logic, analyzing field data, and research, cannot overcome. The crux of the situation is that the complex systems that we ascribe to our reservoirs are much simpler than many of us realize. On this note we can look forward to great progress in the future. ★ ★ ★

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Development Problems in Scurry County Fields

K. MARSHALL FAGIN*

THE discovery of a thick oil-producing limestone reef of Canyon age by the Standard Oil Company of Texas in its Jessie Brown No. 1 last November and the subsequent discoveries in Scurry County have greatly intensified the search for similar oil fields along the eastern rim of the Permian Basin of West Texas. About 12 producing wells have been drilled and completed in the North Snyder field, which is thought to include the Sunray's (Ryan-Hays and Burke) Brown No. 1, a recent discovery about 2 miles south of the Standard of Texas' area.

Five wells have been completed in the "Diamond-M" Canyon reef field about 12 miles southwest of North Snyder, which was discovered by Lion Oil Company's C. T. McLaughlin No. 2 on January 6, 1949. Two Canyon reef wells have been completed by Humble Oil and Refining Company about 2 miles south of the Diamond-M field. The discovery well was Humble's R. Bishop No. 1, which was brought in on March 4, 1949.

More than 35 wells are now being drilled in Scurry County alone. Most of them are extension and development wells in the three areas mentioned above. A few of the others are developing the area midway between the Diamond-M pool and North Snyder where Magnolia Petroleum Company has discovered production in Canyon and Strawn formations. Magnolia's A. B. Eiche No. 1, about 4 miles west of Snyder was completed recently for 166 bbl per day on a 10/64-in. choke from the Canyon lime pay at 6767 ft.

Two small Ellenburger fields have been discovered so far. One is the Humble's B. A. Moore No. 1-B in section 492 about 1 mile north of Dermott, which was completed on April 25, 1949, for a pumping potential of 47 bbl of fluid per day, cut with 2 to 5 per cent water, from perforations from 8200 to 8240 ft. The other was discovered by Placid Oil Company's Cornelius Davis No. 1, which is about 3 miles east of the North Snyder field. Placid's R. H. Odom No. 1, the second well in this field, was completed in May for a pumping potential of 96 bbl of oil per day from the Ellenburger at 7713 ft.

*Editor, Exploration, Drilling, Production.

EXCLUSIVE

Rigs and Equipment

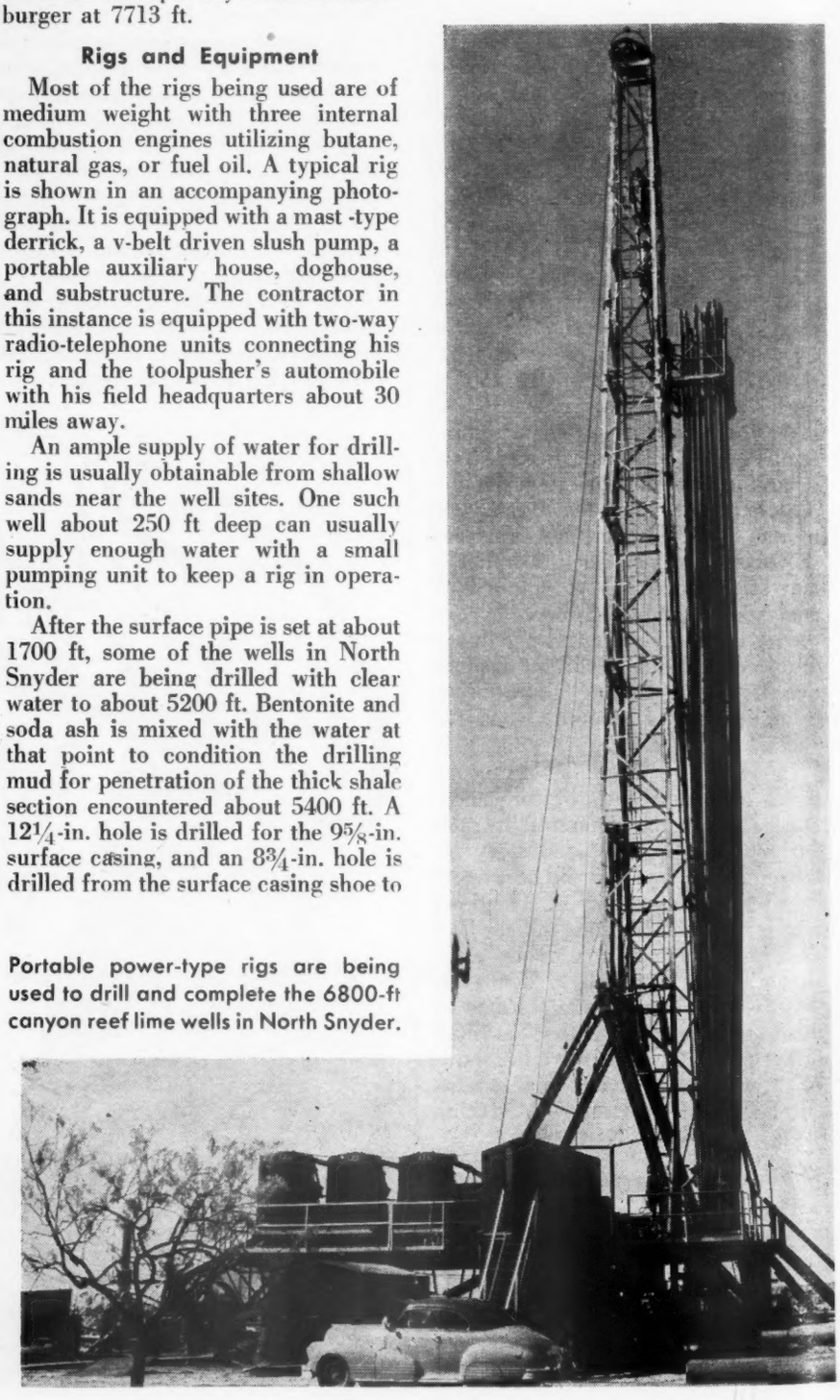
Most of the rigs being used are of medium weight with three internal combustion engines utilizing butane, natural gas, or fuel oil. A typical rig is shown in an accompanying photograph. It is equipped with a mast -type derrick, a v-belt driven slush pump, a portable auxiliary house, doghouse, and substructure. The contractor in this instance is equipped with two-way radio-telephone units connecting his rig and the toolpusher's automobile with his field headquarters about 30 miles away.

An ample supply of water for drilling is usually obtainable from shallow sands near the well sites. One such well about 250 ft deep can usually supply enough water with a small pumping unit to keep a rig in operation.

After the surface pipe is set at about 1700 ft, some of the wells in North Snyder are being drilled with clear water to about 5200 ft. Bentonite and soda ash is mixed with the water at that point to condition the drilling mud for penetration of the thick shale section encountered about 5400 ft. A 12¼-in. hole is drilled for the 9⅝-in. surface casing, and an 8¾-in. hole is drilled from the surface casing shoe to total depth in the producing formation for the 7-in. casing being used for the oil string. About 50 rock bits are required to drill the 8¾-in. hole.

About 40,000 lb of drill collars are used on 4½-in. drill pipe in drilling the 8¾-in. hole. Two drill pipe protectors are being used on each joint of pipe, and about 40 to 60,000 lb of weight is carried on the bits. About 50 to 60 days are required to move in, rig up, drill, and complete a 6800-ft Canyon reef well in North Snyder.

The North Snyder discovery well, Standard of Texas' Jessie Brown lease No. 2 well No. 1, was spudded in on



Portable power-type rigs are being used to drill and complete the 6800-ft canyon reef lime wells in North Snyder.

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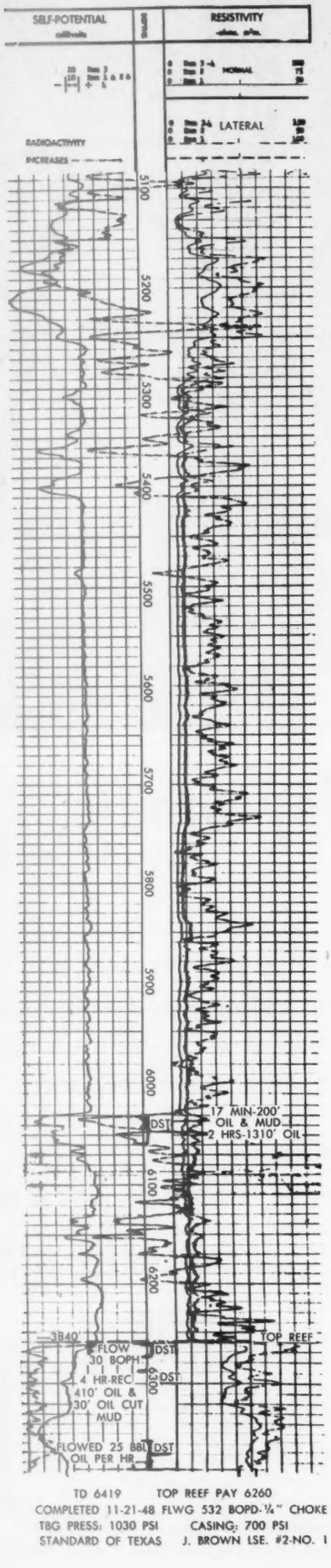
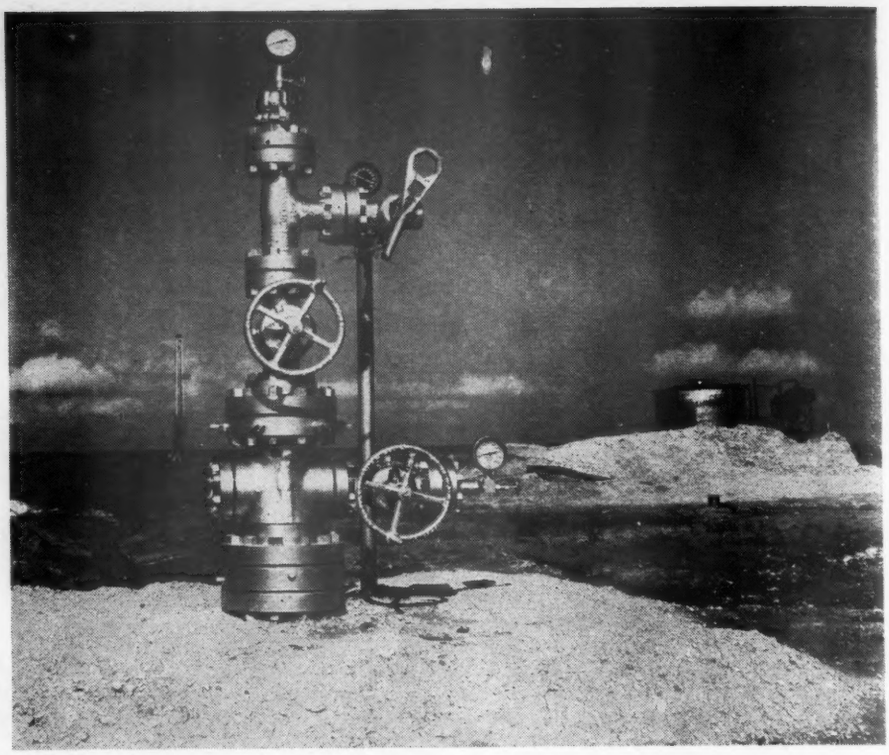
Electric log of North Snyder discovery.

Courtesy West Texas Electrical Log Service, Dallas, Texas.





Christmas tree on Sunray's (Ryan-Hays and Burke) Brown No. 1 discovery well 2½ miles south of the North Snyder discovery well. A rig on the east offset is seen in the distance.

August 10, 1948. A conductor string of 13⅜-in. pipe was set at 386 ft and cemented with 435 sacks of cement. The surface pipe, 9⅝-in., was set at 1730 ft and cemented with 1016 sacks. The top of the San Andres was called at 1620 ft, and the elevation of the well was 2419 ft.

The top of oil sand above the reef was called at 6028 ft. An 8-ft 8-in. core was recovered from 6033 to 6043 ft, of which about 5½ ft was sand, and the remainder was sandy shale. A drill stem test indicated oil production. Six more cores were taken from 6043 to 6287 ft. These showed more sand and alternate layers of sand, shale, and lime. The top of the Canyon reef was called at 6260 ft, and 3 ft of porous lime was recovered on a core from 6266 to 6672 ft. A 2½-ft core of gray dense fossiliferous lime was recovered from 6272 to 6287 ft.

The well was completed on November 21, 1948, about 100 days after it was spudded, for an initial potential of 532 bbl of oil per day with no water on a ½-in. choke through 2-in. tubing. The gas-oil ratio was 1225 cu ft per bbl, and the gravity of the sweet oil was 42.5 API. The tubing pressure was 1030 psi, and the casing pressure was 700 psi.

The second well in the field was Standard of Texas Jessie Brown lease No. 2 well No. 2, the east offset to the No. 1. It was spudded in on December 2, 1948, and completed on February 28, 1949, about 88 days later. The elevation was 2461 ft, and the top of the reef pay was 6578 ft. The 7-in. oil string was set at 6586 ft and cemented with 600 sacks of cement. The well was drilled to a total depth of 6870 ft, and flowed 752 bbl of oil per day on a 22/64-in. choke on 2-in. tubing run to 6845 ft. The gas-oil ratio was 806 cu ft per bbl, the gravity of the oil 43 API, the casing pressure 735 psi, and the tubing pressure was 825 ft.

The wells in North Snyder were allowed to produce 350 bbl of oil per day without any shutdown days during May. Since no water was being produced, it was not necessary to treat the oil. Gas separated in 3 by 16-ft separators was being used on the leases and for operating drilling rigs. An extra 3 by 11-ft separator was installed at each tank battery for continuously testing the wells. The batteries had 4 1000-bbl tanks, and the oil was being shipped to the new Pasotex Pipeline Company terminal in the field.

The ultimate production from reef-type fields such as North Snyder and Diamond-M is as difficult to estimate as the fields are to find. Considerable development may be necessary to determine the extent of these fields, and similar ones that may be found in this area. ★ ★ ★

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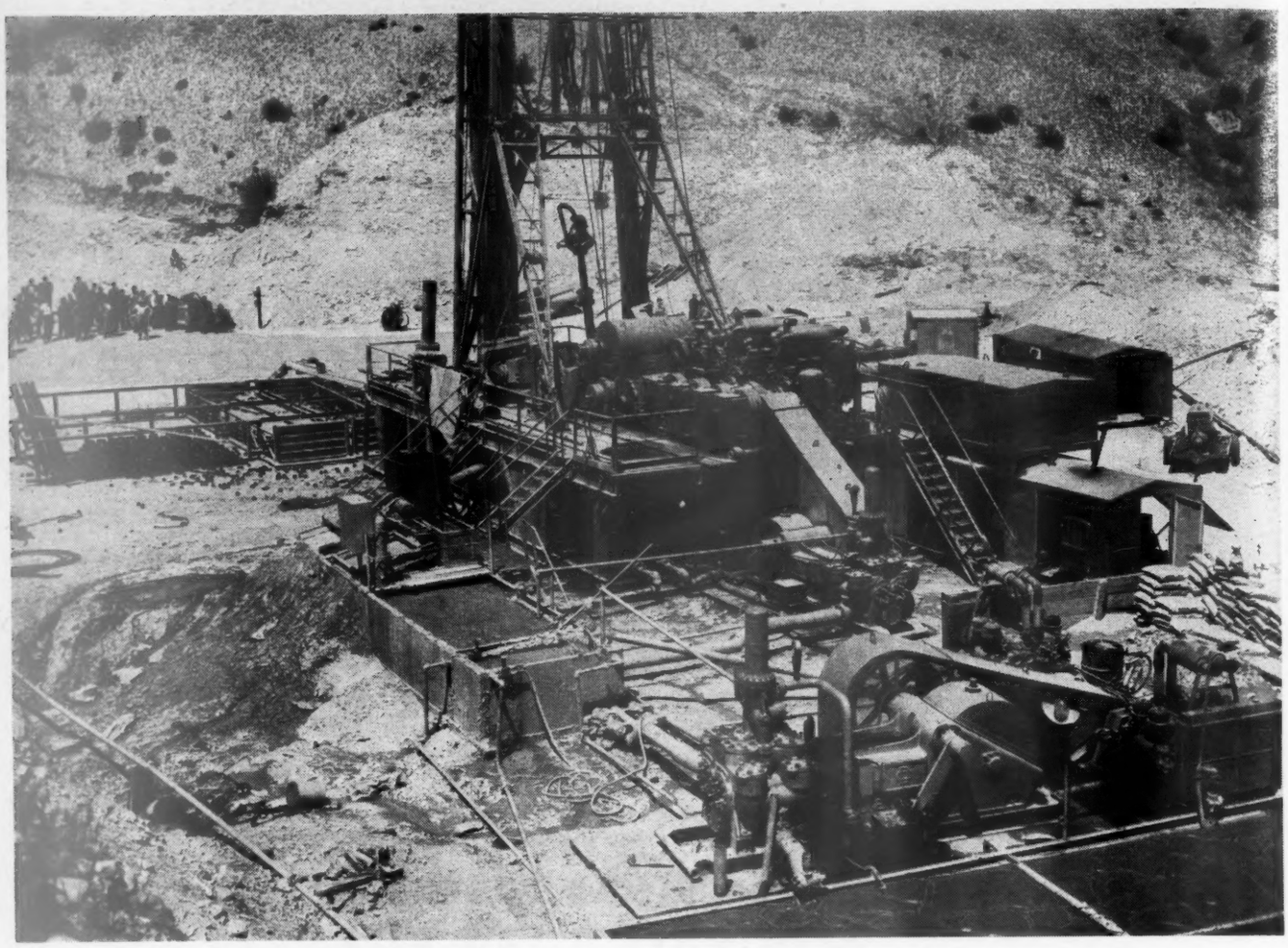

Drilling rig used on south Cuyama discovery well by Rushing Drilling Company for Richfield Oil Corporation.

Discovery Expands Cuyama Valley Fields

RICHARD SNEDDON*

ON May 4, 1949, with a sizable audience present to see it happen, Richfield Oil Corporation further added to the potentiality of Cuyama Valley by bringing in its Homan wildcat for an initial production of 5088 bbl of 34 API gravity oil and 1,500,000 cu ft of gas. The new well is some 5½ miles southeast of Russell 43-8, the nearest producer in the Russell Ranch area; is bottomed in the Dibblee zone at 4392 ft, and has an oil sand penetration of approximately 282 ft. This discovery opens to exploitation a separate oil pool of apparently large dimensions, and making the third discovery by Richfield in less than a year.

*Pacific Coast Editor.

The original discovery well, Russell 28-5, was completed in June 1948. The new area has been named "South Cuyama."

Homan No. 1 was drilled by Rushing Drilling Company under contract for Richfield, and was spudded on April 2, 1949, so that it was completed in just about a month. This brings the total wells drilled or drilling by Richfield in the Cuyama field to 115. Out of these 22 were abandoned, 73 are on production, and the rest are in various stages of development. The daily production amounts to about 15,000 bbl a day with the wells cut back to almost a tenth of their potential. Pipe line facilities capable of handling 50,000 bbl of crude a day have already been installed between the Cuyama fields and the company's plant at Maricopa, and well completions are being continued at the rate of one every 72 hr.

EXCLUSIVE

According to Frank Morgan, vice president in charge of production, there are probably 7 to 9 additional areas that might be worthy of testing on the basis of geophysical work already done, and three geophysical parties are still checking various other prospective sites. Western Geophysical Company has carried on these surveys through the preliminary explora-

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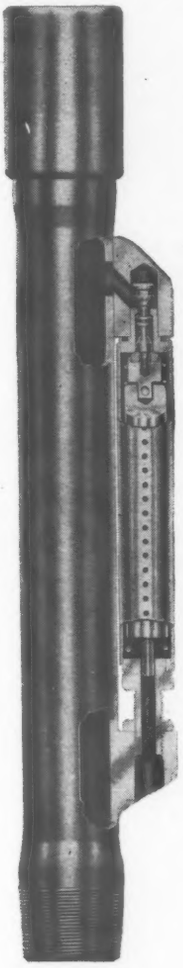

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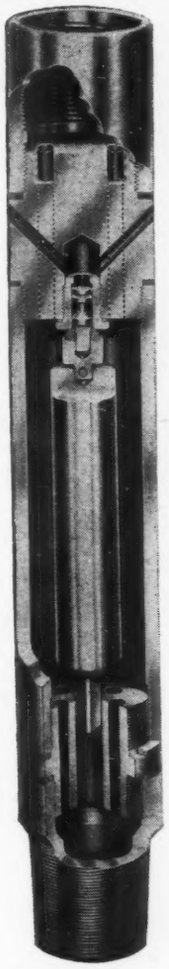

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In many instances a major increase in production has occurred.

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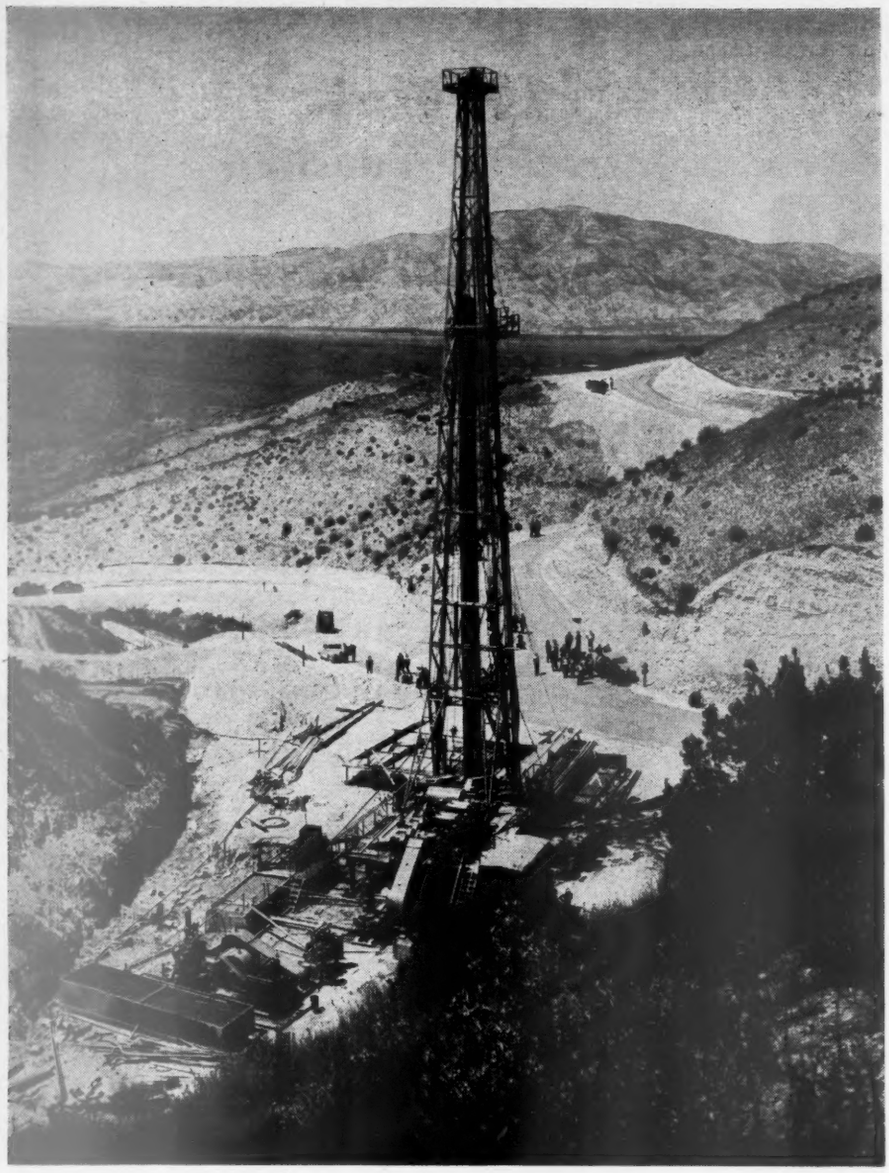


Discovery well in South Cuyama field, which came in flowing over 5000 bbl.

Newsmen quiz Richfield's Norman Simmonds, assistant to the president (second from left), and Frank Morgan, vice president (second from right).

tion period and up to the present time. Up to the moment of writing no outlet is available for the gas but a compression and absorption plant is under construction and should be ready for operation in the near future. It is expected that gas will be compressed in two stages—first, to 450 lb, and then 1500 lb, before the dry gas is injected back into the formation.

It is an interesting fact in connection with South Cuyama that the 320-acre plot on which the Homan well was drilled was acquired by Glenn Homan from the United States Government by payment of the usual $10 registration fee and 50 cents an acre for the mineral rights. The total cost to him, thus, of a productive property that ought to bring him in a comfortable fortune if its present promise holds good was $170. It is just about a year since Homan first filed on the parcel, and his quick rise to fame made good front page copy for many a western newspaper. He is a comptroller for the Halliburton Cementing Company, and an amateur geologist who confesses that this is the first time he has ever made a successful strike as a lessor.

With the exception of 6 wells, all Richfield producers in the Cuyama Valley are bottomed in the Dibblee zone, which is believed to be in the Vaqueros, of lower Miocene age. The Dibblee is about 600 ft shallower than the Colegrove sand and is of much greater extent than the latter. It appears from the results so far obtained that the productive formations trend in a southeasterly direction from the White Rock area, and it seems fairly certain that more separated reservoirs will be located in due course. Most of the dry holes drilled have been west of the original discovery section, where sites were not chosen so much because of chances for success but because of contractual obligation.

Further completions in the Dibblee zone in South Cuyama are expected momentarily. Richfield's Homan No. 1 was in Section 35-10N-27W, and the company has an offset immediately to the east on the Hibberd lease on Section 36. Advance reports on this well indicate that it will eventually core even more sand than the Homan. It is somewhat higher on the structure. Then there is the Superior Oil Company's Buzard et al No. 18 on Section 25, a northeasterly offset to the Homan. This well is also reported into the Dibblee sand as this is written, and may prove to be another good producer. Superior is also making plans to drill a Heath well as an easterly offset to the Buzard.

With Norman Simmonds, assistant to the president, in charge of arrange-

ntrol gate advancement in a decade!

AFTER A LONG PERIOD of engineering development and testing, Shaffer proudly announces its new Shaffer Hydraulic Cellar Control Gate—*two* separate ram compartments unitized into *one* body *with an overall height of less than 30" even in sizes as large as 13⅜"*—as well as space savings in both length and width!

That's *real* compactness—that saves valuable cellar space on every rig where it's installed—that permits more compact hook-ups, more space in the cellar for other equipment, plus vital space savings in storage and shipping.

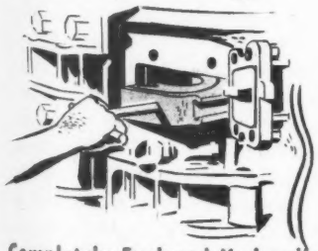
Note in the accompanying table the amazingly small overall height of the new Shaffer Hydraulic Gate in the various sizes. Then remember—this small height includes *two* separate ram compartments in the *one* body—in reality two hydraulic gates in one.

SHAFFER HYDRAULIC GATE DIMENSIONS

Gate Size	7"		9"		11"		13"	
Test Pressure (PSI)	6,000	10,000	6,000	10,000	6,000	10,000	6,000	10,000
Bore	7 1/16"		9"		11"		13 5/8"	
A—Height . . . inches	25	26 1/2	25 1/4	27 1/2	27 1/2	30 1/2	30	36 1/4
B—Width . . . . inches	28 5/8	31 1/2	31 5/8	35 1/4	34 1/4	37 5/8	40	40 1/2
C—Length . . . inches	70 3/4	70 3/4	71	72	79	81 1/4	88 1/2	88 1/2

New Simplicity In Changing Rams

Best of all, unusual compactness is only *one* of *many* new features in the Shaffer Hydraulic Cellar Control Gate. It's the simplest Gate you ever saw when it comes to changing rams. Each ram assembly is readily accessible through a quick-opening side door hinged to the Gate body. By simply unbolting the door and swinging it open, the ram assembly can be pulled right out. Change the ram assembly, slide it back in—then close and bolt the door. It's so simple, so quick, so time-saving it beats anything you've ever seen for fast ram changes!



Completely Enclosed Hydraulic Operation

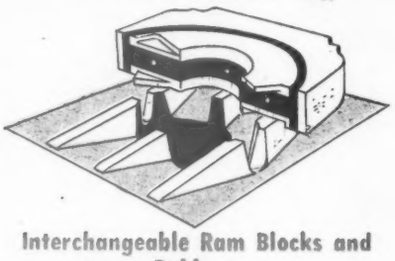
Here's something else—all moving parts in the hydraulic cylinder, including piston rod ram shafts, are completely enclosed. There are no moving parts projecting from the Gate—nothing to become damaged or wedged by loose pipes or timbers in the cellar—nothing to become corroded by salt fluids or chemical muds dripping down into the cellar. Even the locking shaft is completely enclosed and stays enclosed in all positions because it is non-rising.

Corrosion-Free Hydraulic Cylinders

All operating parts in the hydraulic cylinders are of either stainless steel or manganese bronze. Therefore, although hydraulic oil is recommended as the operating fluid, water can be used without risk of corrosion, rust or damage to parts.

Self-Draining Ram Compartments

Another important point—note how the rams travel on high narrow guide ribs raised above the steeply sloped bottoms of the ram compartments. No detrimental sand and mud accumulations can interfere with the operation of the rams because mud and sand drains right back into the well from the Gate body. Any that does remain is far below the ram operating level and does not interfere with free ram travel—therefore cannot keep the rams from closing and sealing.



Interchangeable Ram Blocks and Rubbers

Shaffer Hydraulic Cellar Control Gates have still another advantage—they use the same ram rubbers and ram blocks, size for size, that have proven so dependable in mechanically-operated Shaffer Cellar Control Gates. Where both types of Shaffer Gates are used in a field, ram rubbers and ram blocks can be used interchangeably, reducing inventories and simplifying maintenance!

GET THE FULL STORY of this great new Shaffer advancement. There are many other features you should know about. Write for complete details!

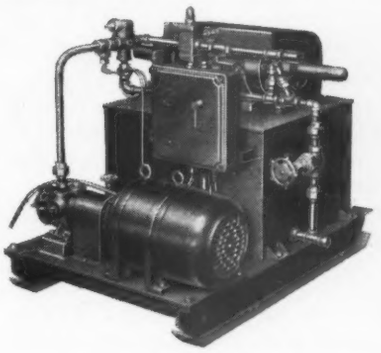
Send for your copy of the complete Shaffer catalog.

Compact Power Closing Units

Because of its lower overall cost, its savings in maintenance and its low freezing point, it is recommended that hydraulic oil in a closed system be used to operate Shaffer Hydraulic Gates. Two types of power closing units are available for supplying the necessary pressure—one operated by electricity, the other by air, gas, steam or water pressure—thus providing a type of power to meet every rig requirement.

Both types have high volume pumps which assure closing the Gates within seconds.

In addition Shaffer Hydraulic Gates can also be opened and closed mechanically, assuring full protection in case of power failures.



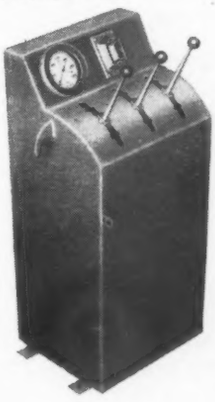
Centralized Control Panel

Complete control of the power closing unit, as well as of the opening and closing of the rams in both compartments of the Gate, is centralized in a compact unitized control panel that can be placed alongside of the driller or at any other convenient location.

Three manually-operated 4-way hydraulic valves are built into the panel—two of the hydraulic valves control the opening and closing of the rams—one for each compartment of the Double Gate—and the third valve can be used to control other hydraulic equipment or to operate another Gate.

These valves can also be operated by remote control, permitting auxiliary control stations to be installed at a distance from the rig if desired—an important safety feature.

The entire control panel is unitized and can be moved from rig to rig with minimum installation and break-out time.



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C. S. Jones, president of Richfield Oil Corporation, announces results of the initial gauges of Homan No. 1.

ments, Richfield flew some 50 or 60 newsmen and oil editors from Los Angeles to Cuyama to see the Homan well swabbed in on May 4. President C. S. Jones played host to this group, and was ably assisted by Frank Morgan, vice president; Bill Travers, assistant manager of exploitation; Rollin Eckis, chief geologist; Mason Hill, district geologist; Harold Linhoff, manager gas department; Earl Gray, production superintendent, northern division; C. K. Curry, general superintendent, northern division; and Edgar Valby, gas department engineer. The well blew in on the seventh swab and was promptly brought under control, after which the party was taken on a tour of the entire field. Upon their return the guests were dined in the company's field quarters, and President Jones announced the results of the preliminary gauges on the new well. It was then cut back, and at last accounts was flowing approximately 600 bbl through a 20/64-in. choke.

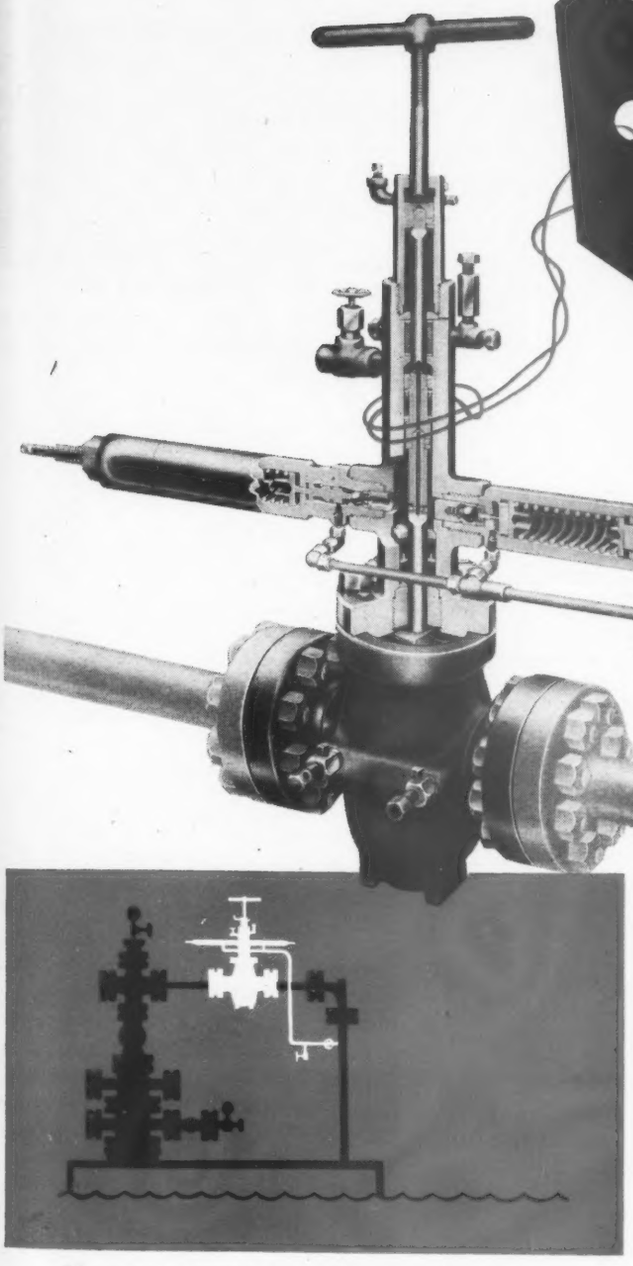
There seems to be little doubt that the South Cuyama discovery opens an extensive new pool to further exploitation, and, indeed, by this time it must be rather obvious that Cuyama Valley generally has all the ear marks of a major California field. Even the once skeptical geologists are now convinced that other pools will be found, and the generous recovery to date is stimulating lots of action. Richfield has a total of about 150,000 acres under lease in Cuyama Valley.

In any case, Cuyama is the biggest oil find in California in a decade and it is sure to have a pretty extensive play during the coming year. The success of the Homan well strengthens the common contention that other such reservoirs as South Cuyama may be found. Another stimulating factor is low drilling cost—Richfield's wells have run from $35,000 to $60,000 apiece.

* * *

TYPE XFG OTIS SURFACE SAFETY VALVE

automatic flow line shut-off upstream from surface choke . . . plus dependable flow line protection downstream from surface choke



Illustrated above is the new Type XFG Otis Surface Safety Valve designed especially to provide these specific operating and safety features:

1. Can be installed in a flow wing to provide a positive shut-off at a point *upstream* from a surface choke.

2. Should surface choke damage or failure, line breaks, freeze-ups, etc., occur, spring-loaded pilots (which control the Surface Safety Valve closing mechanism) are actuated as pressure differential across the surface choke varies from a pre-determined range.

3. When fluid is exhausted through the pilots into the flow line at a point *downstream* from the surface choke, the gate is driven down from a fully-opened to a positive closed position, thus shutting off all flow through the line.

For complete information on the new Type XFG and all other standard Otis Surface Safety Valves, write Otis Pressure Control, Inc., Box 7206, Dallas, Texas.

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SURFACE SAFETY VALVE

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What's Doing in DRILLING

Louisiana Field Opened

A Beauregard Parish, Louisiana, oil field has been opened by Barnsdall Oil Company in the East Longville area, three miles east of the Longville field.

The No. 1 Jones, 3-6s-9w, flowed 390 bbl of oil daily through 12/64-in. choke from 8320-36 ft. Ratio was 1450 to 1.

New Wildcat Staked

Mid-Continent Petroleum Corporation of Tulsa, Oklahoma, wildcatter in Jack County, North Texas, has staked another wildcat in the Post Oak area of northern Jack.

It is the No. 1 J. F. Boyd, 3170 ft from east and 2890 ft from south lines of S. H. Hazel survey, with a 6700 ft contract. The location is approximately 1¼ miles southeast of the Sinclair Prairie Oil Company and Taubert and McKee No. 1 Boyd, Hazel survey, which opened the original Post Oak pool in April 1942, with completion from the Ellenburger lime.

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California Discovery Made

An oil discovery in the Lion Mountain of Ventura County, California, marks Humble Oil and Refining Company's first discovery since the company undertook an exploratory drilling campaign in the state some six months ago.

The company's 1 E. Hammond, 18-3n-22w 1½ miles southeast of Ojai, flowed by heads through a ¼-in. choke at the rate of 70 bbl a day of 23 deg gravity oil from sand of Eocene age. The well was drilled to 4350 ft and plugged back to 4048 ft with interval at 3990-4035 ft perforated with 270 shots.

Deep Kansas Producer

A new producer in the Camp pool of Carter County, Kansas, has been completed by Continental Oil Company at the No. 1 Eason-Harris, in SW NE SW of 6-2s-3w, with pay from the Martin sand.

Drilled to 6615 ft, perforations were made from 6170 to 6204 ft, 6226-43 ft, and 6248-91 ft, and on initial pump test, made 31 bbl of oil in one hour. Final pump test was 160 bbl of oil in 24 hr.

Conoco's No. 1 Fletcher-Barker-Williams, in SW SE SE of 6-2s-3w, was drilling below 5970 ft, while the No. 5 Sidney Eason, in SW NW NW of 6, was making hole below 5532 ft.

Production Test Made

Continental Oil and Joe Dyer have made first production test at the No. 7 Franz, in NE SE SE of 35-28n-3w, in the old Webb pool of Grant county, Oklahoma.

After running 2½-in. tubing to 4336 ft, the well flowed 551 bbl of oil in three hours through open tubing, showing a casing pressure of 160 lb with 260 lb on tubing. Total depth is 4342 ft with 7-in. casing set at 4306 ft; top of the Wilcox is 4313 ft. The Franz was shut in for tank room.

Pool Opener in Kansas

A new pool opener has been discovered by Anderson-Prichard Oil Company in Rice County, Kansas. Its No. 1 Ringwald NE SE NE 32-18-10, one and one-half miles south of the North Orth pool, flowed 206 bbl of 40.3 gravity oil and three bbl of water in 13½ hr through a one-in. choke. Later it flowed 84 bbl of oil, no water, in 18 hr through a ¼-in. choke.

Three Discoveries Reported

Three new discoveries, one in the tidelands, have been reported for South Louisiana.

About nineteen miles off Vermilion Paris, Superior Oil No. C-1 State gauged 2,920,000 ft of gas daily through 14/64-in. choke plus five bbl of condensate from 7415-430 ft. Tubing pressure was 2930 lb.

Midway between the Bayou Mallet and South Bayou Mallet fields, Acadia Paris, Callery and Hurt of Houston, Texas, have completed No. 1 Goss, 13-7s-1e, for 180 bbl of oil daily through ⅛-in. choke from 8497-503 ft. Tubing pressure was 1520 lb. A quarter mile southwest of the Sunshine field discovery, Iberville Parish, Sohio and Sinclair No. B-2 Nelson, 1-9s-1w, has been completed for 285 bbl of oil daily through 5/32-in. choke from 10,294-303 ft. Gas-oil ratio was 452 to 1. Sohio's discovery well flowed oil and water from about 8900 ft.

Wyoming Block Proved

Continental Oil Company has another "discovery" well on its 13,376-acre unit bock in townships 42n-78w and 42n-79w, in southeastern Johnson county, Wyoming, at its No. 5 Unit, in SE SW NW of 32-42n-78w, the Sussex Unit area. The well is three miles southeast of production on the block.

Lakota sand was called at 7548 ft (minus 2376 ft) and correlates 33 ft higher structurally than the discovery. On drill-stem test at 7459-85 ft, there was a recovery of 4800 ft of clean oil and 30 ft of oil-cut mud; there was no water.

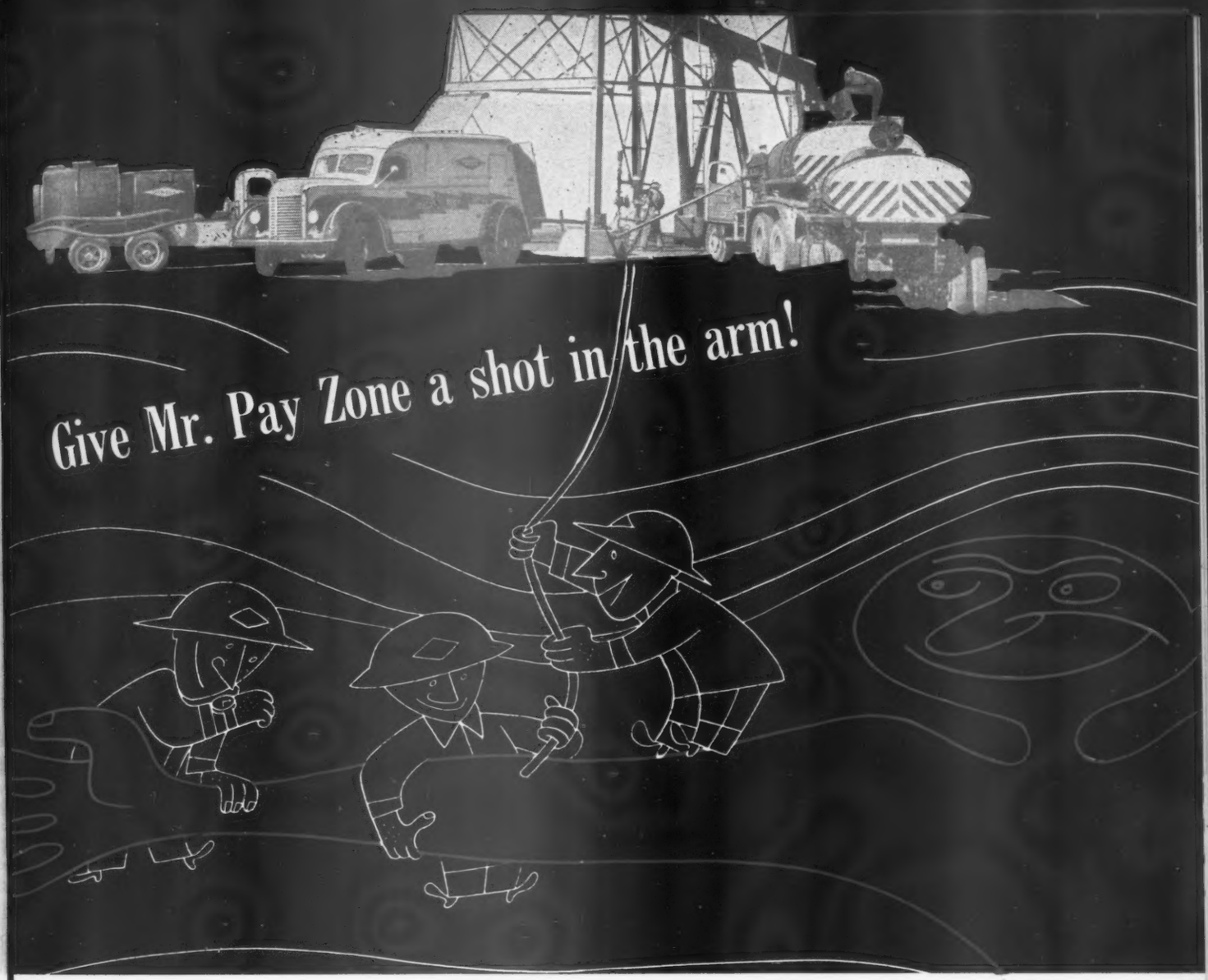
Finals Given on Three Wells

Archer County is leading North Texas oil activity at present, with final completion reports on three discoveries.

W. J. and John J. Moran finaled their strike south of the Vogtsberger field, No. 1 McGregor in 4-1-H&TC, with a 4-hr flow of 88 bbl through a quarter choke from pay at 3867-78 ft.

The same partners' No. 2 Hammond, four miles southwest of Scotland and in the Corzine survey, flowed 84 bbl of oil in six hours through a quarter choke from Strawn at 3855 ft.

A. R. Dillard No. 2 Schenk, in 20-3-Clark and Plumb survey, pumped 18 bbl daily. It is five miles southwest of the Scotland field.



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To get more oil from your wells, acid treatments should be directed accurately into selected zones. Look to Dowell for this service—*selective acidizing*, using the Electric Pilot.

Drawing on experience gained in acidizing thousands of wells, Dowell engineers work with you, correlating an Electric Pilot permeability survey with other well data, to determine the zones which should respond to treatment. Then, with the aid of the Electric Pilot, they *acidize just those zones*. For example: A north Texas well was producing ½ barrel of oil per hour and had a gas-oil ratio of 20,000 to 1. After selective acidizing, the well produced 50 barrels of oil per hour, and the gas-oil ratio was reduced to 500 to 1!

Selective acidizing is advantageous in most old wells, particularly those with residual oil to be recovered from tight sections; those with high gas-oil ratios, intermediate water zones or leaking casing seats; and those plugged back from bottom water or deepened to new pay zones. It is of value for new wells with saturated zones of varying permeability or those with a change of formations within the open hole.

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FOR OIL INDUSTRY CHEMICAL SERVICE

75th Producer Completed

West side of the Northeast Elmore pool has yielded the 75th producer for the Garvin County Oklahoma, field, at the Carter Oil No. 5 Dena Sullivan, in NW NE SW of 9-2n-2w.

After drilling plug from casing set at 6666 ft, tubing was run to 6675 ft and mud displaced with 180 bbl of load oil. Swabbing down, the well flowed back the load and then flowed 257 bbl of new oil in 15 hr through a ¾-in. choke. Gas-oil ratio was 1400-to-1.

Utah Field Adds Well

Eleventh producer in the new Ashley Creek field of Uintah county, northeastern Utah, has been reported at the Stanolind No. 3 USA, in NW NE NW of 26-5s-22e. It is the third producer for the company in that area.

The No. 3 USA had Weber sand at 4145 ft, drilled to 4287 ft, and flowed 98 bbl of 32-gravity oil in four hours, then was shut in. Stanolind has established "pipeline proration," to limit 120 bbl of oil per day per well.

All wells in the field—the first commercial oil pool in the state—have been spaced on a 40-acre pattern and it has been agreed between operators that this pattern will be followed during primary development of structure.

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Present at a recent meeting of the East Texas chapter of API in Kilgore were: John Poore, engineer for General Electric Company, Dallas, Texas, who presented a film concerning electrification of the petroleum industry; Carrol Deely, president of Drilling and Service, Dallas, Texas; Robert Watson of Drilling and Service, guest speaker on the subject of diamond bit coring practices; B. F. Patterson, engineer for The Texas Company in the East Texas area and chairman of the East Texas chapter of the API; John Calvert, Humble Oil and Refining Company, Overton, Texas, secretary-treasurer of the chapter; and William Holland, East Texas Engineering Association, Kilgore, assistant secretary-treasurer.

Rework Well

The Coke field in Wood County, Texas, has been given a Rodessa zone oil producer in the reworking of a well completed in 1945 as a gas-distillate discovery. A completed gauge on file for Amerada Petroleum No. 3 E. L. Faulk, Knight survey, showed it had been refinished for 245.49 bbl of 47.3-gravity oil daily. That flow was through 12/64-in. choke, and gas-oil ratio was 2077 to 1.

Production is coming from 8080-130 in the Young section of the Rodessa. It is from this same section that the well was first completed making 32,000,000 ft of gas daily along with 57 bbl of distillate per million feet.

Strike Ready to Complete

The recent Stanolind Oil and Gas strike in New Mexico is ready for completion. The Ellenburger discovery is on the east side of the Langlie-Mattix field in Lea County, New Mexico.

The No. 1 South Mattix unit, 15-24s-37e, was to go on production following tests at 9564-614 and 9512-64 ft. From the deeper section, after 2000 gal of acid, it flowed 261 bbl in four hours through 19/64-in. choke. From the other section, after 3000 gal of acid, it made 465 bbl in four hours through 16/64-in. choke. Ratios were 365 to 1 and 922 to 1.

Committee Heads Named

Chairmen and committee members for the American Association of Oilwell Drilling Contractors convention September 19-21 have been announced by Joseph S. Morris, association president.

Louis A. Beecherl, Dallas, Texas is chairman on general arrangements. Other chairmen, all from Dallas, include J. E. Brantly, program; J. L. Rush, housing; W. L. McClusky, registration; C. J. Paine, entertainment, and George B. Rice, transportation.

Drilling Company Expands

The Falcon Seaboard of Canada, Ltd. has been formed as an extension of Falcon Seaboard Drilling Company of Tulsa, Oklahoma. The new company has already begun moving drilling rigs into Alberta province and plans for additional rigs as the development of Canadian reserves expands.

B. Frank Bridges, formerly of the Gulf Refining Corporation, will be president and resident director of the Canadian company, and will have his headquarters in Calgary.

Theodore N. Law, Tulsa, president of Falcon Seaboard Drilling Company is vice president of the new firm. J. L. Stauss, vice president of Falcon Seaboard will be vice president in charge of operations of the Canadian company. C. M. Bailey, assistant secretary of the Tulsa drilling company, will be secretary and treasurer.

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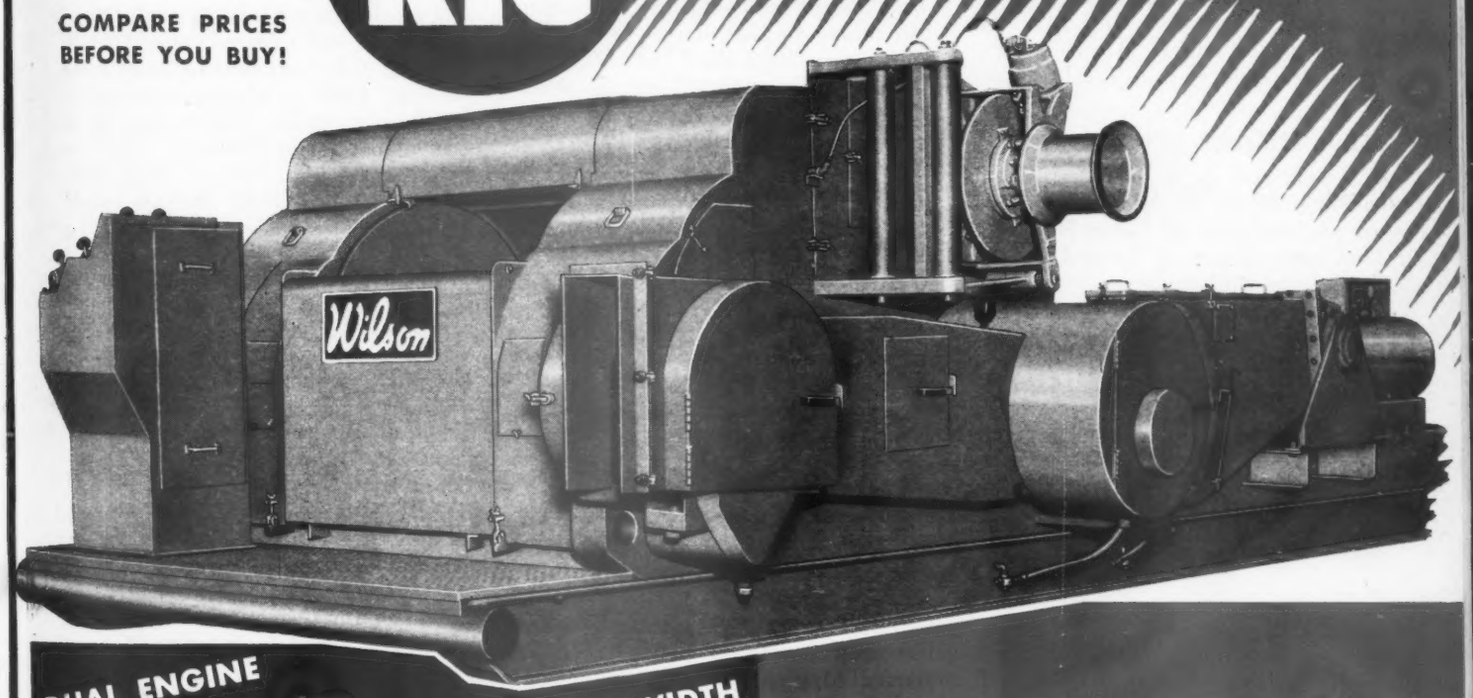

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NEWS

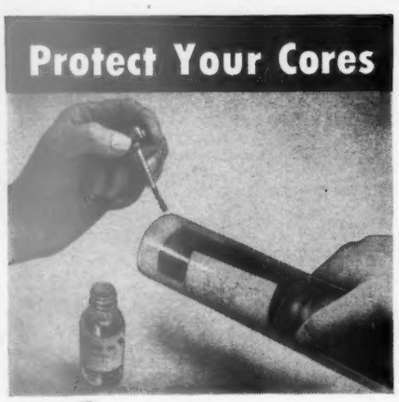
API Officers Elected

The following officers were elected to the advisory committee of the Pacific Coast district, division of production, American Petroleum Institue at their spring meeting in the Biltmore Hotel, Los Angeles, California.

M. B. Standing, chairman, California Research Corporation, La Habra; E. Robert Burns, vice chairman, Los Angeles basin district, McDonald and Burns, Torrance; A. B. Dooley, vice chairman, San Joaquin Valley district, Beldridge Oil Company, McKittrick; Benton Turner, Jr., vice chairman, coastal district, Lloyd Corporation, Ventura; R. W. Walling, vice chairman, Coalinga-Kettleman district, division of oil and gas, Coalinga; C. T. Reichert, treasurer, National Supply Company, Torrance; Mrs. Elsie M. Edmiston, secretary, American Petroleum Institute, Los Angeles, California.

Move Offices

Meyer and Achtschin, petroleum consultants have moved into their new offices, 1600 M & W Tower Building. They were formerly located in the Continental Building.



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Progress Reports of Venezuela Fields

Progress reports on Venezuelan oil fields including those of the Colon Development Company, Ltd. with three fields, are as follows:

The first, Las Manueles, with a daily production at the end of the year of 2516 bbl, which was considerably less than the 3487 bbl at the end of 1947. No wells were drilled during the year.

In the Las Cruces, El Cubo, Colon Development Company production was 6943 bbl daily, also under 1947, and no wells were drilled in this area, which was opened in 1916.

The West Tarra field, which opened in 1947, drilled 2 new wells during 1948, producing a total of 1569 bbl daily at the end of the year.

The Mene Grande field, Shell Caribbean Petroleum Company, had a considerably higher daily production average in 1948 than 1947. In 1948 the average was 45,772 bbl compared to 40,126 bbl in 1947. A total of 19 new wells were drilled in 1948. The Mara was producing 35,491 bbl daily at the end of 1947 compared to 27,915 bbl daily at the end of 1948, with two new wells drilled.

Venezuelan Oil Concessions Limited, Cabimas field was producing some 14,505 bbl daily at the end of 1948, compared to 84,570 bbl daily in 1947.

Tía Juana had a daily average of 43,319 bbl daily, compared to 182,022 bbl daily in 1947. This difference occured despite the 84 new wells drilled in 1948. At the Lagunillas field the daily average at the end of the year, 1948, was 61,667 bbl with 10 new wells, compared to 319,745 bbl daily average in 1947. Pueblo Viejo produced a daily average of 937 bbl at the end of 1948, which was considerably less than the 6,216 bbl being produced at the end of 1947.

The Venezuelan Oil Concessions in Sibucara, opened in 1947, produced an average daily output at the end of 1948 of 2805 bbl, with one new well. The Bachaquero field had a daily average at the end of the year of 92,340 bbl in 1947, compared to 70,127 bbl in 1948. Daily production average in the La Concepcion field at the end of the year was considerably more in 1948, 4,007 bbl, with one new well, and 2831 bbl in 1947. Average crude oil produced at the end of 1948 in La Paz was 123,422 bbl daily, with 4 new wells, compared to 96,330 bbl daily average at the end of 1947.

Second Mud School Begins

A total of 130 advance registrations were received for the series of mud schools initiated by the University of Alberta for drilling crews in Canada, in cooperation with the American Association of Oilwell Drilling Contractors. Since this enrollment exceeds the number that can be successfully handled at two sessions a day for the two-week course, a second school, started May 30, following morning and evening sessions which got under way May 16.

New Montana Oil Officials

Governor John W. Bonner has appointed the following named persons members of the Oil Conservation Board of the State of Montana to serve for and during the remainder of the current terms of the former members ending January 8, 1950, to-wit:

George N. McCabe, of Cut Bank, Montana, Jack C. Toole, of Shelby, Montana, Peter A. Thomson, of Billings, Montana, Ted Hawley, of Conrad, Montana, and, J. R. Engelking, of Kevin, Montana.

At the first meeting of appointees to board membership, George N. McCabe was elected chairman, and Jack C. Toole, vice chairman. At the same meeting, James A. MacGowan, of Great Falls, Montana was appointed secretary of the board to succeed R. P. Jackson, who served in that position continuously since January 1934, retiring from service effective May 1. A. B. Gillespie was re-appointed auditor, Lila J. MacGowan, clerk-stenographer, and the continuance of the principal office of the board in the Ford Building in Great Falls, was authorized.

Profit Sharing Pays

Thomas P. Pike Drilling Company of Los Angeles attributes a sharp increase in their profits to their incentive management and profit sharing plan. In spite of the fact that competition has lowered drilling rates, while the cost of equipment and supplies has risen 25 per cent, their net for the past nine months is up by a substantial percentage.

Thomas P. Pike, president of the company, is one of the trustees of the council of profit sharing industries, which held a regional meeting at Memphis, Tennessee recently. He agrees with his fellow members of the council, that profit sharing offers vast opportunities for both capital and labor to cooperate in expending our free enterprise system, and raising the standard of living in America.

EXPLORATION ACTIVITIES

Nebraska Showing Made

An encouraging show of oil at a depth of 4400 ft in its wildcat test in the Gurley area, Cheyenne county, Nebraska, has been reported by The Ohio Oil Company.

Harold H. Healey of Casper, division manager, said the well, No. 1 M. E. Egging, had reached its first objective at 4400 ft and that the showing was sufficiently encouraging to run casing for further testing.

Oil Field Evident

North Haskell County in West Texas, has tangible evidence of a new oil field as Humble Oil and Refining Company proceeds with testing at its No. 1 Burson, six miles southwest of Weinert and 10 miles east of the Jud field, opened recently by Danciger Oil and Gas.

The Humble prospect, located in block 12, J. Koris subdivision, was estimated good for 200 bbl daily from Strawn sand at 4735-55 ft. After exploding 90 quarts of nitro in the section, the wildcat made heads of 25 and 50 bbl and continued cleaning out.

Discovery Well Killed

The Bay Petroleum et al No. 1 Frank Parkes, discovery oil well in NE NE SW of 34-4n-8eCm, in the Cimarron County, Oklahoma field, after flowing 74 bbl was killed and another 15 shots perforated in the Keves sand at 4804-09 ft, after flowing 74 bbl of high-gravity oil in 13 hr through a 1-in. choke.

Meantime deals were in the making for two new outposts in the general area south and southwest of the town in Keyes, on farm-outs from major companies.

The Parkes well was drilled to the Mississippi lime at 4818-55 ft total depth, with pipe set at 4843 ft. Casing was perforated at 4814-19 ft for a show of gas and oil; next perforations were at 4809-14 ft in basal part of the sand, and there was a flow of gas with spray of oil. After shooting 15 holes at 4808-99 bbl of oil ft the well gauged 11.69 bbl of oil in 50 min, then tanked 74 bbl of oil in 13 hr. Gas gauged 3,150,000 cu ft a day.

Because of the broad leaseholds, there are few if any open leases in eastern part of Cimarron county. Royalty trading has not yet reached the "fever heat," which was expected.

Seismic Crews Hunt Oil in East Texas

Seismograph exploration is now spread over 14 counties in East Texas, and later reports are that there are 13 shooting crews out of the total 19 parties counted.

Wood county leads the activities with three parties, followed by Cass and Cherokee with two each. Quintana Petroleum is the most active company with four parties, followed by Humble Oil with three, Shell and Amerada with two each.

Quintana, with headquarters at Houston, moved into the district in scattering its crews along the south side. In the Yellow Pine area of Sabine County, the company has both seismic and gravity crews.

One of Humble's seismics is south of Garrison, in Nacogdoches county; the other southwest of Winnsboro in Wood. The other Wood crew is an Amerada coredrill southwest of Quitman. Amerada's second unit is a seismograph southwest of Fincastle, Henderson County.

Shell Oil has a seismograph southeast of Tulington, Freestone County, while a company gravity unit is working in East Navarro County. Skelly is shooting north of Hughes Springs, and Stanolind south of Bivins. Texas Company has a seismic west of Alto and Union Producing a party north of Jacksonville.

Farmout Deal Made

Two additional explorations are in store for the Kelly pool area four miles west and south of Snyder, Scurry County, Texas, as a result of a farmout deal.

The farmout was from Magnolia Petroleum, pool discoverer, to H. J. Shipley and others, Lubbock, Texas. The tract, on which two locations have been staked, is southwest of Magnolia No. 1 Moore, Canyon reef well.

Shipley et al. No. 1 Ida Maxwell is 660 from the north and east lines of 191-97-H&TC, making it a southwest offset to the Moore well. The No. 2 Ida Maxwell is one location south of the No. 1 Maxwell.

Northwest of the Moore well nearly two miles, Magnolia No. 1 Eickle, 209-97-H&TC, was testing in the reef at 6710-78 ft. After treatment with 200 gal of mud acid, the well kicked off to flow in six 28 bbl of new oil in six hours through quarter choke.

Kansas Gets New Pools

Trego and Cowley counties, in widely separated areas of the Kansas oil fields, got new oil pools during the past month.

The Trego strike is Bennett and Roberts Drilling Company and associates' No. 1 Carpenter, in the SE SE SW of 13-11-23w, east of the Wakeeney pool, which was assigned a potential of 51 bbl of oil daily from the Lansing-Kansas City lime series at 3586 ft, total depth. It is the discovery well in the Wakeeney East pool.

Woods Drilling Company No. 1 Fry, in the SW NW SW of 27-33-6e, northeast of the Rahn oil pool, Cowley county, is making an estimated 100 bbl of oil daily from the Bartlesville sand at 2907 to 2934 ft. It also is northeast of the Each gas area.

Arkansas Drilling Speeded

Production discovery in the Hogg sand zone in the old Stephens field of Columbia and Ouachita counties, Arkansas, has resulted in the fastest drilling campaign in that state in several years.

A month ago Zack Brooks Drilling and C. G. Davis opened the zone at their No. 1 Hamilton, in section 19-15s-19w, on the Ouachita county side, with pay at 3243-53 ft. The well flowed 18 bbl of oil an hr through a ¼-in. choke.

Since that time there has been 23 locations staked, with 12 oil wells and three dry holes completed. Pay zone ranged from 3200 to 3270 ft, with production from 95 bbl pumping to 250 bbl flowing. Oil tests 34 deg gravity, with low gas-oil ratio. Development has led to several small trades, wherein leaseholders have sold old properties or royalty owners have cashed out.

Exploration Contract Let

Contract has been let for a long-planned Woodbine exploration in Leon County, while field reports point to other early wildcat operations in other East Texas areas.

The Leon well will be drilled by W. L. Pickers, Dallas, Texas, about four miles east of Jewett. Contract for the 6500-ft hole was let to Watts Drilling Company, Arp, Texas. The drilling prospect was worked up by Sam M. Aronson, Dallas geologist. It is covered with about a 7000-acre block which Bonner Smith, Jewett, was instrumental in assembling.

Second Pool Opened

Exploration work by Carter Oil continues in northeastern Kansas after opening of a second oil pool at Wabaunsee county wildcat which is showing improved output. It has staked a site for another test in Nemaha County.

Located south of the town of Alma, Kansas, Carter's second discovery well in the general area of the Forest City basin and the Nemaha trend, No. 1 Davis, in SW SE SW of 33-13s-10e, was testing in the Viola and averaging 26.38 bbl of oil per hr.

After drilling plug from casing set in the Viola at 3201 ft crew swabbed out mud, and then made 52½ bbl of oil in six hours through 2½-in. tubing.

Continuing to swab, the production stepped up and on another six-hour test, the well made 158.32 bbl of oil, to indicate better than 600 bbl per day. The crude was cutting about 2 per cent mud. Total depth is 3206 ft.

Alberta Well Brought In

For the second time in three weeks, four oil companies operating jointly in the Redwater field in Alberta, Canada, have brought in a heavy flowing well.

The Barnsdall Oil Company, operator for the partners who include the Honolulu Oil Corporation, Los Nietos and Seaboard Oil, announced the well came in with a flow of 1542 bbl a day from a depth of 3240 ft. The first well was brought in in April with a reported initial flow of about 1000 bbl per day.

Land Department Changes

Sohio Petroleum land department changes include: Frank Johnson district chief at Jackson, Mississippi, moved to Midland, Texas in the same capacity. R. J. Bartlett, formerly at Shreveport, Louisiana moves to Jackson to succeed Johnson.

West Texas Tests Made

Extensive exploration activities are being carried on in some counties of West Texas. Outstanding are plans of Commanche Corporation and others to drill an 8500-ft Ellenburger exploration near the center of the Garza field just south of Post in Garza County. It will be No. 1-A Garza deep-Montgomery-Davies with site 660 from the west lines of 5-5-K Aycock. Regular production in this area is around 2800 ft.

In the Flanagan sector of Gaines county opened by Shell No. 1 Hawkins as an Ellenburger discovery, Magnolia Petroleum is to drill its No. 2 Flanagan estate as a 13,000-ft hole. Site is 660 from the south and west lines of 9-A23-PSL, a half mile south of the discovery.

Drilling Block Taken

H. E. Prather and associates have announced assembly of a 3000 acre drilling block between Canton and Ben Wheeler, Van Zandt County, Texas. The spread begins eight miles east of Canton and extends to within four miles of Ben Wheeler, taking in these surveys: Walters, Slaughter, J. H. Blue, Ochiltree, and McPhail.

Ranch Leased

Further evidence of exploration plans for West Texas was given recently when one of the largest single-ownership lease transactions for Northwest Texas was completed with the execution of 10-year commercial leases on 44,620 acres of the Morgan Jones Ranch of Crosby County, Texas.

The ranch was leased to Chester Imes, Abilene oil operator, and turned to three major companies. Part of the ranch had previously been leased by Ohio Oil Company, which drilled on 8638 ft dry hole on the north end of its block.

Largest of the new lease blocks is 21,825 acres. Another includes 12,080 acres and the third, 10,175 acres.

Makes Alberta Discovery

Canadian Gulf Oil Company officials report their wildcat well No. 1 Ellis flowed at the rate of 1680 bbl a day on a one hour test recently.

The well is 112 miles southeast of Edmonton, Alberta. It is some 70 miles southeast of the Leduc oil field which is south of Edmonton. It was estimated that the daily rate of flow of natural gas was 500,000 cu ft.

Wildcat Leases Taken

Top prices were paid for leases on state-owned tracts to the school land commission in northwestern and western Oklahoma to buyers who moved in that section to fill-in holdings.

Superior Oil Company bid $1,899.20 per quarter-section for the NW and SW of 33-23n-17w, near Quinlan in Woodward County, Oklahoma. The Texas Company took eight tracts in the extreme western part of Woodward county. It paid $49.11 for 17.73 acres, being lot 1 in NE of 15-29n-19w, and $2,843.20 for the SE of 16-29n-19w; and $710.80 for the SW SE of 17-29n-19w; and $1,021.60 for the N½ SW of 27-29n-19w; and $621.60 for the W½ NW of 32-29n-19w; and $230.80 for NW SE of 1-28n-20w; and $150.80 for the SW SW of 1-28n-20w, and same price for the NW NW of 12-28n-20w.

R. R. Sheets paid $1,920 for half-minerals in the N½ NE and SW NE of 32-11n-21w, near Elk City and north of the Elk City field in Beckham county.

Gulf Oil Corporation paid $3,680 per quarter-section for the NE and NW of 16-12n-26w, and $2,480 for the 10-11n-26w. Shell Oil paid $408 for the S½ NE of 9, and same for S½ NW of 10-11n-26w.

Sunray Oil paid $985.60 for lease on the N½ SW of 16-15n-3e, in Lincoln county, while Lewis A. Wallace, Jr., paid $122.50 for the NE NW of 16-8n-2e, Pottawatomie county.

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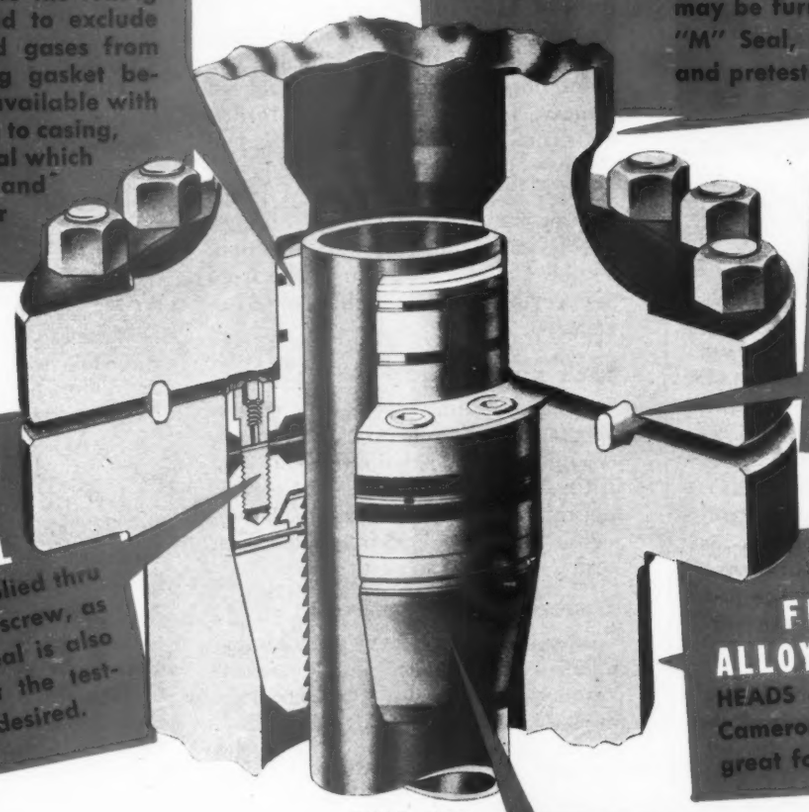

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Tunisian Permits Obtained

Shell and Gulf Oil Companies have been granted oil prospecting permits in Tunisia, French Official Quarters have announced. The Tunisian affiliate of the Shell group has obtained a permit for around 2,500,000 acres in the Sahel region, and Gulf has obtained some 5,000,000 acres in Central Tunisia.

Joins Murphy Oil

Charles H. Hoke, formerly with Phillips Petroleum at Evansville, Indiana, has been made chief geologist for C. H. Murphy Oil Company, El Dorado, Arkansas.

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Elk Hills Reserves Will Be Developed

The 3000-acre Elk Hills naval petroleum reserve, near Taft, California, which taps an estimated 650,000,000 bbl of oil, may be completely developed within 10 years.

Some 475 wells, to be drilled under an $80,000,000 program already under way, plus 500 wells now in a state of readiness, will give the nation a substantial petroleum backlog in case of emergency.

Production capacity of the field when fully developed will exceed 100,000 bbl a day, Commander F. L. Ruhlman, USN, inspector of naval petroleum reserves in California, said. The Elk Hills reserve has completed eight of a planned 300 deep wells. Drilling will not begin on 175 shallow producers for at least two years, Commander Ruhlman says.

The deep wells (7000 ft) are capable of flowing an average of 300 bbl a day each. Capacity of the reserve's 500 present wells, all shallow (3000 ft) is 65,000 bbl a day.

Three Counties Explored

Borden County, Texas, where a deep Ellenburger project is to be drilled by Ryan, Hayes, and Burke of San Antonio, is one of the three widely scattered counties in the West Texas district slated for wildcat explorations. In the northeast part of the county, the well is No. 1 Herd estate, 660 from the south and east lines of 418-97-H&TC.

Amerada Petroleum announced footage for its 6000-ft wildcat three miles northwest of Idalou, Lubbock County. The No. 1 C. D. Bradford is 660 from the south and west lines of the lease in 35-D7-ELRR.

Atlas Exploration Company, Houston, has started a 3100-ft Ellenburger test 18 miles northwest of Junction, Kimble County. Location is 330 from the north and west lines of 47-4-TW&NG.

Seek Ellenberger

Callahan County has a new exploration, Richtex Petroleum No. 1 Bartlett, two miles north of Sydney, Texas, and in the SW/4 of 5-H&TB. On the seismograph farmout from Sohio, its objective is the Ellenburger, in West Texas.

Explore East Texas

Interest in East Texas work mounted higher recently when announcement was made of a 4500-ft exploration six miles south of Rusk, Cherokee County, and of plans for a shallow try in McLennan county.

The Cherokee County venture will be drilled by R. J. Caraway, Dallas, Texas wildcatter. It will carry the designation of No. 1 Ray Magee and is located 330 ft out of the northwest corner of the lease in the E. Moseley survey.

Sarida Oil Company, Houston, Texas, will go into the area two miles north of Crawford, McLennan County for a 1200-ft test. It will be No. 1 T. Compton, 330 from the northwest and 900 from the southeast lease lines in the A. Ybarbo survey.

Two Operations Set

An 8000-ft exploration in Southeast Gaines County split West Texas developments with Scurry County where Barnsdall Oil announced a 7-well program for the area south of North Snyder.

The Gaines test will be drilled by Forest Oil and Anderson Prichard as No. 1-A Parmer County school land. Site is 860 from the west and 660 from the south lines of 12-317- Parmer CSL, 15 miles southeast of Seminole.

Also in Gaines and a half mile south of Shell No. 1 Hawkins, Ellenburger discovery 12 miles south and west of Seminole, Shell has staked No. 2 Hawkins as a 7300-ft Clearfork test. It is 660 from the south and east lines of 8-A23-PSL.

West Texas Wildcats

Wildcat explorations have been staked in three West Texas counties, two of them on the east rim of the Permian Basin.

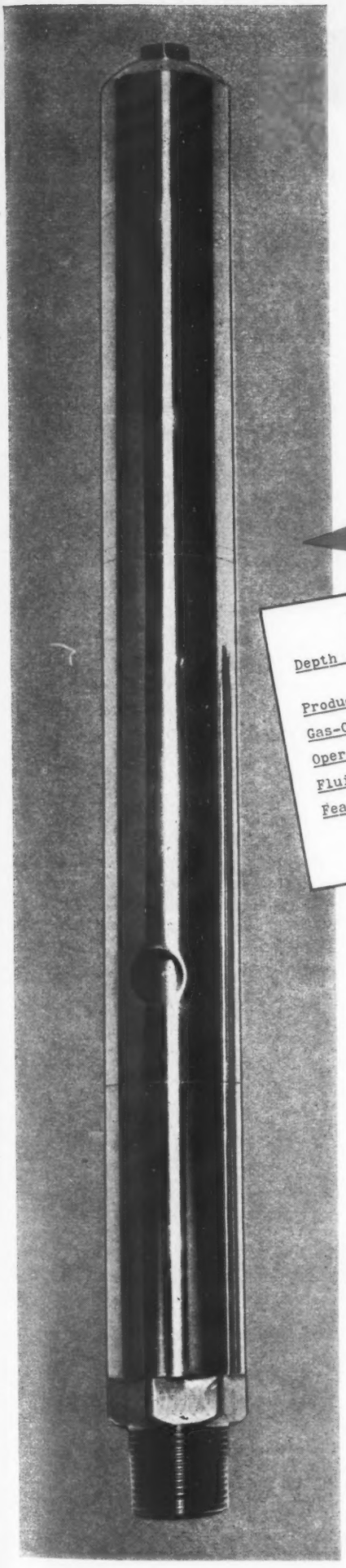
In Coke County, Humble Oil is to drill No. 1 James L. Brunson as a 5300-ft test two miles southeast of the Bronte field. Location falls out of the southeast corner of section 331, N. Eastland survey.

In Glasscock County, Southern Minerals Corporation, Corpus Christi, Texas, has scheduled a 6000-ft hole twelve miles west of the Howard-Glasscock field and southeast of Stanton. Location is 660 from the north and west lines of SE/4 of 13-36-2s-T&P.

Pecos County got a shallow 1700-ft test over a mile north of the Taylor Link pool. Site is 330 from the south and east lines of NW/4 of 20-16-U.

Ellenburger Test Made

American Liberty Oil Company, Dallas, Texas, is starting an Ellenburger test to 4700 ft three miles east of Hamilton in Hamilton County, Texas. The project is No. 1 Bywaters, located 1980 south of the E. Fulcher survey, but in the D. H. Williams survey.



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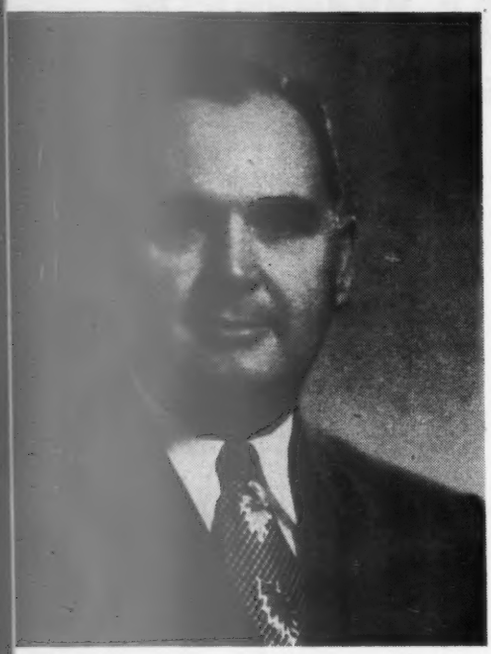

H. O. Harder
Sunray Oil Corporation

▸ **H. O. "Bud" Harder,** general superintendent of Sunray Oil Corporation's production department, was elected vice president in charge of production by the directors of the corporation to succeed James K. Ellis, resigned. Ellis, who is moving to San Antonio, Texas to become associated with the Slick-Urschel Oil Company interests, will remain a member of the Sunray board of directors. Harder has been associated with Sunray since 1945, when he joined the company as assistant general superintendent. He was named general superintendent of Sunray's producing operations in the fall of 1947. Prior to 1945, Harder had worked in engineering and supervisory capacities for Cities Service Oil Company and Indian Territory Illuminating Oil Company throughout the Mid-Continent area. He was graduated from the University of Oklahoma in 1927.

Harder has learned the oil business the hard way. He started at the bottom in roustabout gangs, working through the Seminole, Texas, Bristow, and Oklahoma City, Oklahoma, booms, and today directs Sunray's extended field operations throughout Kansas, Oklahoma, Texas, and other states.

Harder has a happy faculty of remembering names, dates, and places. For close paper work at the office, Bud's doctor has lately recommended reading glasses. "Now," said a secretary in the Sunray production department offices at Tulsa, "we never will get anything by him."

Sunray's directors re-elected all other officers at the last board meeting. These include **F. B. Parriott,** chairman of the board; **C. H. Wright,** president; **F. L. Martin,** executive vice president; **Edward Howell,** Oklahoma City, Oklahoma, vice president and general counsel; **Paul E. Taliaferro,** vice president and general attorney; **Don O. Chapell,** vice president, exploration and land; **W. D. Forster,** secretary; **L. W. Bennett,** treasurer; **S. P. Gray,** assistant secretary and assistant treasurer.

▸ **Col. Robert W. McClenahan,** formerly assistant chief of staff intelligence for General R. L. Maxwell, Commanding General U. S. Army Forces in the Middle East, and currently an employe of the production department, Gulf Oil Corporation, today received the Order of the British Empire at the British Embassy in Washington. The honor, conferred by Sir Oliver Franks, was in recognition of unusual service during the period prior to the Battle of El Alamein, when Col. McClenahan was largely responsible for obtaining valuable intelligence information on operations in the Middle East and for subsequent work which resulted in the creation of better understanding between the British and American Forces.

Born in Egypt, where his father was Dean of the American University at Cairo, Col. McClenahan came to the United States folowing World War I. Upon his graduation from Princeton in 1924, he studied Mechanical Engineering at the University of Pennsylvania. In 1926 he became associated with the American Meter Company and was located in both Philadelphia, Pennsylvania, and New York. Col. McClenahan volunteered for active duty in the United States Army in the spring of 1942 and was immediately sent to the Middle East.

▸ **Vincent L. Quinlan,** petroleum engineer, Magnolia Petroleum Company, was transfered from the Lake Charles, Louisiana district to the Brownfield, Texas district. Replacing Quinlan is **Jerry V. George** formerly in charge of the Brownfield district.

▸ **W. H. Newman** recently assumed the duties of marine drilling tools supervisor of the Louisiana Gulf district for Magnolia Petroleum Company of Dallas, Texas. Newman has charge of Magnolia's offshore drilling operations. He succeeds the late Goldie S. Wilkie who died suddenly May 16, 1949.

▸ **Julian Q. Myers,** senior geologist at San Antonio, Texas, retired May 1 after 23 years of company service. He began working with Shell as a geologist at Laredo, Texas and was transferred to San Antonio in 1929. He was later made assistant area geologist in Houston, and served as area geologist from 1942 until 1946 when he returned to San Antonio as senior geologist.

▸ **Jack Cashell,** Preston Oil Company, Columbus, Ohio, has been appointed to membership on the production research advisory committee of the Pennsylvania Grade Crude Oil Association, D. T. Ring, Columbus, Ohio, association president, has announced.

Cashell, mine engineering graduate of Ohio State University, joined Preston Oil Company in 1943. His chief assignment has been development of the company's secondary recovery oil projects in Ohio, Pennsylvania, West Virginia and Kentucky.

O. F. Van Beveren

▸ **O. F. Van Beveren** has been named northern district exploration superintendent of Standard Oil Company of California, with headquarters at Bakersfield, California. Van Beveren, a graduate of California Institute of Technology, joined Standard in 1933. He has done geophysical work in Mexico, Java, Sumatra, Saudi Arabia, and Egypt.

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▸ **Jack N. Westsmith** has been employed by the American Association of Oilwell Drilling Contractors to direct public relations and membership work, succeeding Jeff Young, resigned. Westsmith resigned as editor and general manager of Petroleum World, Los Angeles, California, to accept the position in Dallas, Texas. He will spend a great deal of his time contacting members in the various districts, and seeking new memberships. He is a graduate of Stanford University.

▸ Personnel changes involving employes of Stanolind Oil and Gas Company have been announced by R. E. Nelson, Jr., Texas-Louisiana Gulf Coast division manager. They include:

Henry K. Boswell, engineer, made plant foreman at Burnell-North Pettus gasoline plant, Pettus, Texas. He was formerly at Tulsa, Oklahoma.

F. H. Hammons, made party chief of a Stanolind seismograph party at Smithville, Texas. He was formerly an assistant party chief.

▸ **Howard M. Walker** recently assumed the duties of assistant district superintendent in the Lake Charles, Louisiana district of Magnolia Petroleum Company. **Charles B. Swain** has advanced to assistant district superintendent of the Duncan, Oklahoma, producing district, replacing Howard M. Walker. Swain was petroleum engineer specialist in the Oklahoma City division office of Magnolia.

▸ **Leslie (Les) A. Leuzinger** has been appointed petroleum engineer in the Rangely field for the Union Pacific Railroad Company's oil development with headquarters at The Texas Company camp in Rangely field. **Basil V. Savoy** is also with the Union Pacific oil development as junior petroleum engineer, with headquarters at Rock Springs, Wyoming.

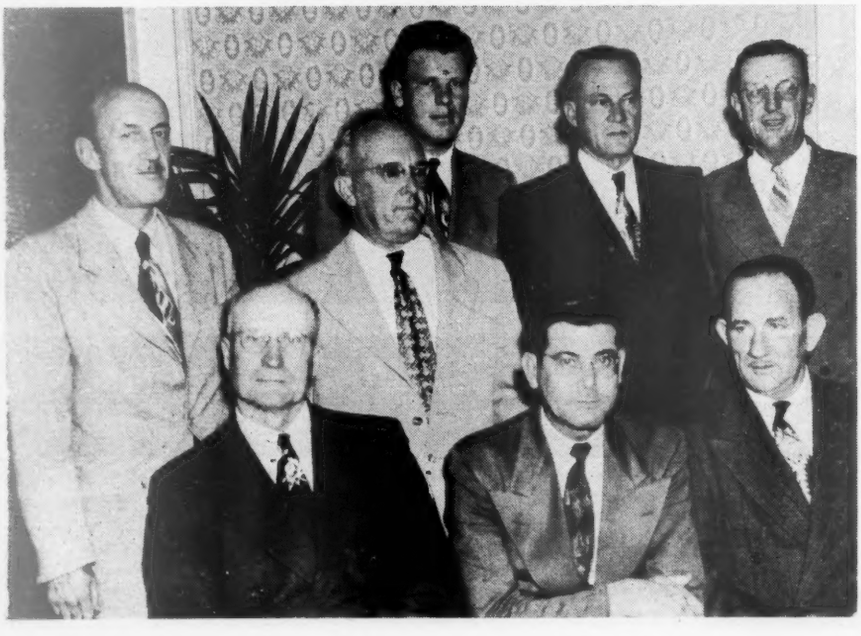
▸ **Frederick C. Beleau** has been named division drilling superintendent for Canadian operations of Stanolind Oil and Gas Company. Beleau, former division drilling superintendent for Stanolind's Rocky Mountain division, with headquarters at Casper, Wyoming, has been with Stanolind since 1933.

Other personnel changes involving men recently assigned to Canadian operations are:

Clarence J. Jinkins, tool pusher, transferred from Houston, Texas; **Truman C. Harman,** farm boss, transfered from Wink, Texas; **Forrest G. Vergne,** field clerk, transfered from Rangely, Colorado; **Raymond T. Stotler, Jr.,** geologist, transfered from Wichita, Kansas.

▸ **Glen Ruby,** internationally known geologist, made an over-night stop recently in Dallas, Texas on his way to Salt Lake City, Utah. Following his trip to Salt Lake City, Ruby left for Portugal where he is engaged in a geological exploration.

Guests of Los Angeles Nomads: Front row: A. L. Owens, Iraq Petroleum Corporation; G. A. Yarberry, Brown Drilling Company; D. W. Patton, Texas Company of Colombia; Second row: W. D. Spicer, Iraq Petroleum Corporation; S. Lae, Sinclair Oil-Venezuela; Don Smith, Kern Trinidad Oil Company; M. O. Smith, Arabian American Oil Company; S. F. Duffield, Thornbury Drilling Company.



▸ **Richard H. Smith** has been appointed general production superintendent of the Signal Oil and Gas Company in a series of promotions announced by Walter Greenfield, manager of the oil producing department of that company. He succeeds E. L. "Gene" Davis who has resigned to accept a position with the Arctic Contractors operating in Alaska.

Richard H. Smith

Named to assist Smith were **Harry C. Meyer,** assistant general production superintendent, and Paul Andrews, chief production engineer. Prior to his association with Signal, Smith was with the Kettleman North Dome Association for many years. He received his technical training at California Institute of Technology and University of Southern California.

Meyer, former lease superintendent of the company's bolsa properties at Huntington Beach, California, will make his headquarters in Los Angeles. Andrews, new chief production engineer, has been with Signal for many years. He is a University of Utah graduate.

In another announcement, Greenfield also named **C. C. "Larry" Liedholm** chief petroleum engineer. Leidholm is a graduate of the University of California and has been a Signal man since his graduation.

▸ Personnel changes involving employes of Stanolind Oil and Gas Company were announced by John R. Evans, North Texas-New Mexico division manager. They include:

Arthur Drexel, production foreman, transfered from East Texas area, Longview, to North Cowden area, Odessa, Texas.

Clinton C. Harbour, production foreman, transferred from Nocona, Texas, to East Texas area, Longview.

E. L. Chapin, petroleum engineer, transferred to Lubbock, Texas, district office from North Cowden area, Odessa, Texas.

W. Keith Miller, geologist, transferred from Midland to Fort Worth.

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4-S—120 TONS
6-S—220 TONS
6HD—300 TONS

The Brewster Model 6-S Swivel shown on this page is a part of a Brewster N-7 Drilling Team now on location in East Texas (contractor's name furnished on request). Operator reports months of satisfactory, trouble-free service.

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BREWSTER MATCHED *Drilling Equipment*

▸ **A. Towle,** director of research of Anglamol Ltd., has arrived in the United States from England to discuss with the Lubrizol Corporation, Cleveland, Ohio, Anglamol's parent company, the coordination of mechanical testing methods in the ecaluation of lubricating oil additives, etc. He is planning to return to England July 15.

▸ **Calvin James Dean,** 50, died Monday, May 9, at his home in South Pasadena. Senior petroleum engineer for the General Petroleum Corporation, Dean was a graduate of the University of California ('23) where for three years he was a member of the varsity football team.

He joined the General Petroleum Corporation one month after his graduation in 1923 and for the next two years worked in the oil fields. In 1925 he became an assistant geologist in Los Angeles, moving to the Bakersfield area the following year where he worked for six years as a geologist and petroleum engineer. In 1941 he returned to the company's headquarters in Los Angeles.

▸ **Lawren G. Morris,** chief computer for Seismograph Service Corporation, has moved from Tulsa to Oklahoma City, Oklahoma. **Hewlett A. Russell,** geologist at Graham, Texas, for a number of years, has moved to Wichita Falls, Texas.

▸ **Bert Ryan,** Shell Oil Company, has been transferred from Houston to Midland, Texas, after being appointed Midland area manager. Before his transfer, friends and associates in the company presented him with an electric drill press, at a farewell party held in the Lacquer Room of the Rice Hotel.

▸ **Reese H. Tucker** has been named chief geologist for Cities Service Oil Company (Delaware) and **A. K. Wilhelm** has been appointed executive assistant in the geological department, according to an announcement by A. W. Ambrose, company president.

Tucker has been manager of the company's geophysical section since June of last year. He was first employed by Cities Service Oil Company as a junior engineer in 1930 after graduating from the University of Colorado. He was assigned to the geological division, where most of his time was spent in geophysical work.

Wilhelm steps into the new post of executive assistant in the geological department after almost four years as Bartlesville division chief geologist. He graduated from Penn State with a B.S. degree in mining geology.

Guests of Los Angeles Nomads. Front row: H. D. Husky, Iraq Petroleum Corporation; C. D. Hendershott, Bahrein Petroleum Corporation. Second row: T. E. Patton, Arabian American Oil Company; D. E. McGehee, Standard Oil Company of NJ-Egypt; W. Ziloff, French Petroleum Institute; C. H. Vincent, British Malayan Petroleum Company (Shell). Third row: S. P. Duffield, Thornbury Drilling Company; M. R. Teague, Standard Oil Company of NJ-Egypt; Charles H. Looper, Iraq Petroleum Company; C. L. Tidwell, Syria Petroleum Company; Jack Walsh, Iraq.

▸ **B. P. Eastin** has been appointed regional exploitation engineer of Shell Oil Company. Eastin replaces W. C. Chonette, who was recently made division manager, Los Angeles basin division.

▸ **Harold M. Fritts,** formerly geologist on the regional staff, has been named exploration manager for Shell Oil Company of Canada, Limited-Western. Fritts began working for Shell in 1927, at Coleman, Texas, as an instrument man on a field party. In the intervening years he worked in practically all of the exploration districts of the former Texas-Gulf area and in the office of the vice president of exploration for Shell in St. Louis, Missouri.

▸ **P. G. Wright, Jr.,** has been promoted from assistant foreman in the Brownfield, Texas producing district to production foreman in the Kermit, Texas district, it is reported by the Magnolia Petroleum Company.

Glen W. Barb, petroleum engineer, formerly located in the Alice, Texas producing district, has been transferred to Morgan City, Louisiana.

▸ **N. A. Tinker,** specialist in reservoir engineering, is now associated with the DeGolyer-McNaughton Company in Dallas, Texas. He was formerly with Weatherford Oil Tool Supply Company of Tulsa, Oklahoma.

▸ Personnel changes involving employes of Stanolind Oil and Gas Company have been announced by F. J. Schempf, central division manager. They include: **James J. Johnson,** petroleum engineer, transferred to the central division office in Oklahoma City, Oklahoma, from Shreveport, Louisiana.

William R. Sype, geologist, transferred to the Central division office from Tulsa, Oklahoma.

G. N. Meade, seismograph party chief, transferred from Rock Springs, Wyoming, to Ardmore, Oklahoma.

▸ **M. C. Hoffman,** general superintendent of Stanolind Oil and Gas Company's producing department, has been named general manager of production and exploration of Root Petroleum Company, Shreveport, Louisiana.

▸ **C. A. Moon,** production manager for Socony-Vacuum Oil Company of Venezuela, has left Caracas for a trip to England. **A. H. Taylor,** safety and training director of the company, has returned to Caracas following a brief home-office visit.

▸ **Don G. Herring, Jr.,** district gelogist for The Texas Company at Jackson, Mississippi, has been transferred to the division office at New Orleans, Louisiana and assigned to the exploration department.

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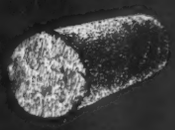
means more core cut per diamond, per revolution



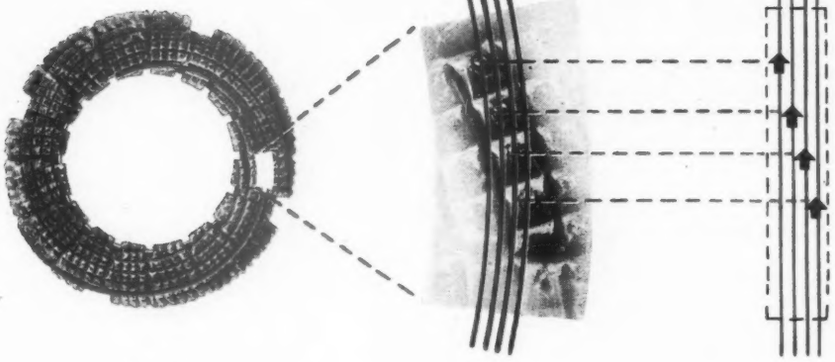


FIG. 1 FIG. 2 FIG. 3

Maximum cutting efficiency (bit cost per foot) in Core Lab Diamond Bits is obtained by expertly selecting and handsetting each stone in a scientifically diagrammed spiral pattern (Fig. 1). This design, assuring that not more than half of the leading edge of each diamond will cut the formation, results in—(A) a smooth shearing of the formation, as compared to an inefficient bouncing action which occurs if the entire leading edge of each diamond is allowed to meet the formation pointblank; and (B) longer bit usefulness through controlled diamond wear.

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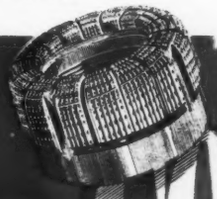

For detailed information, prices, etc., write Core Laboratories, Inc., Box 3310, Dallas, Texas. Ask for illustrated "Spiral-Set" Bulletin.

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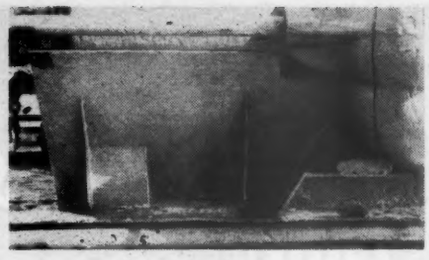
FIELD AIDS

Mud Pump Splash Guard

Water sprayed on the rods of the fluid end of a mud pump, as well as leakage past the packing when working at extremely high pressures, often causes a wet area at the pumps that not only is a hazard to personnel, but also frequently endangers the pump by destroying the foundation on which it rests. One contractor encloses the rods below the truss member of the pump casting by using a three-part guard.



The two wing sections are similar, being made in rights and lefts. One of these is shown in the photograph. It consists of a flat plate of light steel, with ribs and flanges as illustrated to fit on the pump skid and maintain alignment. The lower edge of the flat plate fits down over the skid I-beam. The end piece is made from the same thin plate, formed to fit within the two I-beams of the skid, and with flanges which hold the wing sections in place.

With such a guard, waste fluid is retained within the skid, and may be removed through a drain to the waste pit, mud ditch, or into the fresh water pit if not contaminated by mud. The three-part guard is quickly removed when the pump requires maintenance or repacking.—M.H.P.

"Floating" Back-Up Post

Usual drilling practice is to anchor the back-up post to the top member of the derrick substructure or to bolt it securely to the rig floor. One drilling contractor constructs the usual type of all-welded braced post, but holds it in place only by 40-penny nails through the front edge. The pull of the tongs is counteracted by passing the tong line through the post and down to the substructure, where an eye in the end of the wire line is anchored.

The change in direction of the tong line from the horizontal to vertical is made gradually. A guide or sleeve, of extra heavy 1-in. pipe, is put through the post and welded in place. A 6-in. long protruding end, extending backward away from the derrick floor, is curved to alow the line to slide readily and thus prevent an abrupt change in direction. A tong line anchored in this manner outlasts the eye at the tongs. If extra line is provided when first set up, the damaged end at the tongs may be cut off and new line payed

through the post, much as new drilling line is fed to the drawworks drum. This gives new, undistorted wire line at all three points of wear: the tongs; the slide in the post; and at the anchorage to the substructure.—M.H.P.

Use Acme Cable Tools

TRUSTWORTHY SINCE 1900

Fig. 115 Acme Prosser Swivel Socket

Rope Socket Ruggedness of Half-Century Repute

It's what goes under a drilling tool's surface finish that REALLY counts—down hole. Acme Rope Sockets, remember, have those EXTRA inner-rugged qualities which pay off, in bonus service.

Their every maximum field-service factor is safeguarded, from billet to finished Socket: By our own rigid specifications for PREMIUM-grade steel . . . electric-automatically controlled heat-treatment process . . . master-craftsmanship, to engineered exactness.

Prosser Swivel Socket (Fig. 115) is used on wire cable . . . as are our Babcock (stiff) and Burns Swivel. (Other types for manila cable.) All made to API specifications — unless "special."

Acme's Rope Sockets MUST uphold their 2-generation REPUTATION—for greater stamina and trustworthy performance: "Down-deep" factors that cut drilling cost foot-by-foot . . . Tool-making factors beyond any "stop-watch" limitations.

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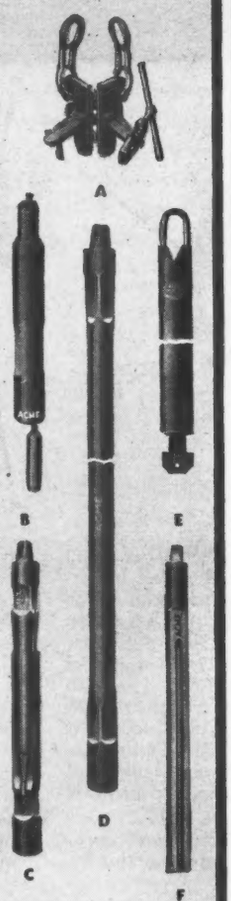

See other Acme Drilling Tools in panel (right) . . for more of EVERYTHING you need in a Trustworthy String.

A—Wire Line Clamp, 12"
B—Prosser Swivel Socket
C—Drilling Jar
D—Drilling Stem
E—Bailer
F—Drilling Bit

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Since 1900

THE *New* GUIBERSON TYPE J DRILLING HEAD

with FULL-FLOATING WASHPIPE

Increased load-carrying capacity... the ideal tool for drilling-in, reverse circulation and clean-out operations.

Check these improved features!

WASHPIPE PACKING ASSEMBLY IS TAMPER-PROOF

•

NO PACKING ADJUSTMENT REQUIRED AT ANY TIME

•

ROTATION IS IN EITHER OR BOTH PACKINGS FOR LONGER PACKING AND WASHPIPE LIFE

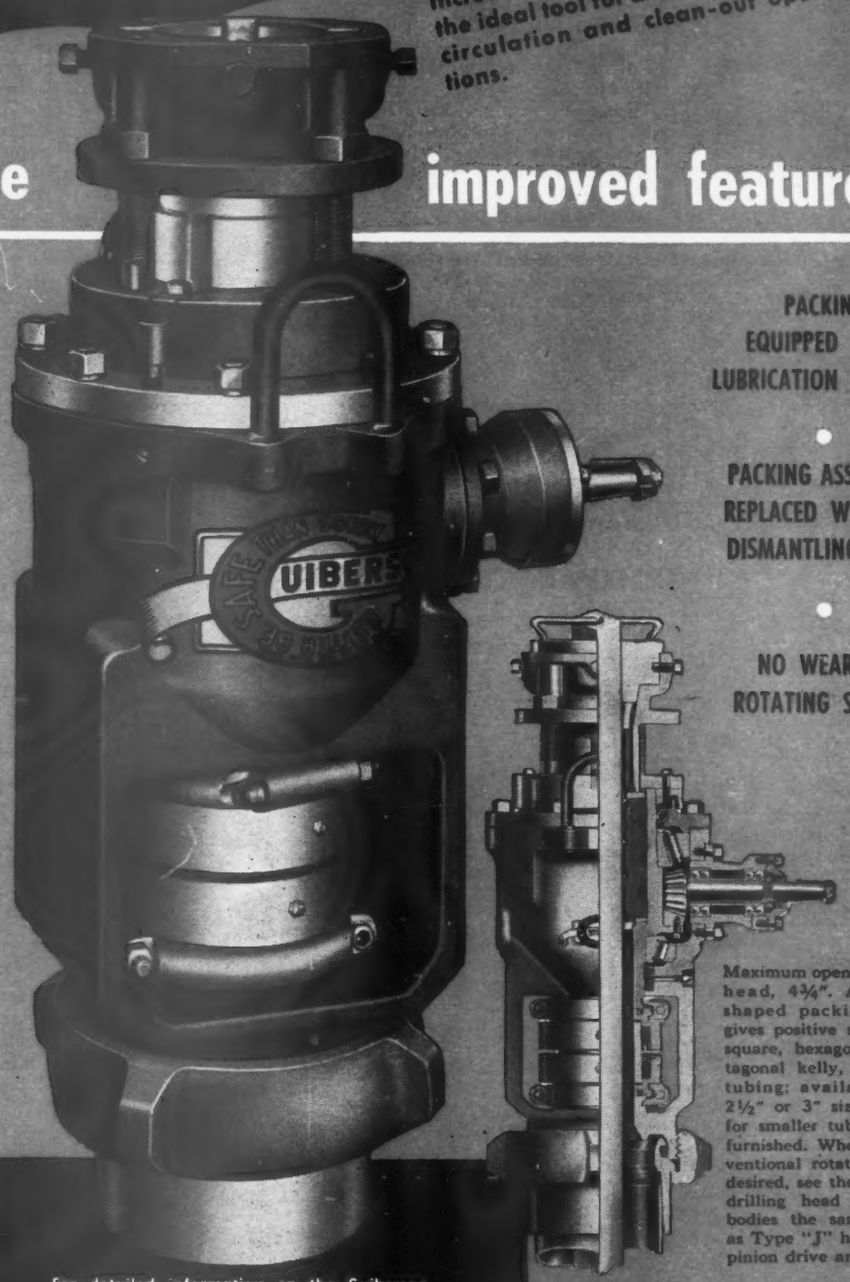
•

NO MUD OR DRILLING FLUID CAN ENTER HOUSING

•

REINFORCED HEAD WILL NOW HANDLE TUBING STRINGS UP TO 8,000 FEET IN DEPTH

•



PACKINGS EQUIPPED WITH LUBRICATION FITTINGS

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PACKING ASSEMBLY REPLACED WITHOUT DISMANTLING HEAD

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NO WEAR ON ROTATING SPINDLE

Maximum opening through head, 4¾". Accordion-shaped packing rubber gives positive seal around square, hexagonal, or octagonal kelly, as well as tubing; available in 2", 2½" or 3" sizes; rubbers for smaller tubing can be furnished. Where the conventional rotating head is desired, see the Type "K" drilling head which embodies the same features as Type "J" head without pinion drive and gear.

For detailed information on the Guiberson Type J Drilling head, write or call the Guiberson office nearest to you.

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DATA ON DRILLING MUD MATERIALS

Common, or trade name	Chemical name, or description	Reason for using	Approximate pH value
Cal seal	Anhydrous calcium sulphate	For lost circulation and setting bridges	
Jelflake	Cellophane strips	Crevice filling	
Baroid 0	Powdered barium sulphates (barytes)	Weighting material	
Bariod 1 to 5	Ditto with 1%-5% bentonite	Weighting and wall-building material	
Micatex	Flakes of mica	Crevice filling	
Mica flake	Flakes of mica	Crevice filling	
Baroco	Powdered clay (sp. gr. 2.5) with 15%-20% colloidal material	Weighting and wall-building material	
Impermex	Starch treated with caustic soda	Wall-building material	
Collox	Powdered iron oxides	Weighting material	
Aquagel	Powdered bentonite (90%-92% colloidal)	Wall-building material	
Anhydrox	Barium carbonate	To counteract anhydrites	
	Disodiumphosphate Na_2HPO_4	To floculate or defloculate mud	8.6
	Tetrasodium pyro phosphate $Na_4P_2O_7$	To floculate or defloculate mud	9.9
	Sodium tetraphosphate $Na_6P_4O_{13}$	To floculate or defloculate mud	8.7
Soda ash	Sodium carbonate Na_2CO_3	To reduce calcium sulphates	11.0
	Trisodium phosphate Na_3PO_4	To floculate or defloculate mud	11.3
	Sodium metasilicate Na_2SiO_3	For low water loss mud	11.6
Caustic soda	Sodium hydroxide NaOH	To preserve starch mud and to increase ph	12.6
Stabilite	Dextrose and phosphate	To reduce viscosity	
	Phosphoric acid H_3PO_4	To reduce ph	1.5
	Gallic acid $C_7H_6O_5$	To reduce ph	3.4
	Sodium acid pyrophosphate $Na_2H_2P_2O_7$	To floculate or defloculate mud	4.8
Quebracho	Crude tannic acid $C_{14}H_{10}O_9$	To reduce viscosity	5.0
Chestnut extract	Crude tannic acid $C_{14}H_{10}O_9$	To reduce viscosity	6.4
Sodium hexametaphosphate	$Na(PO3)_6$	To floculate or defloculate mud	7.0
	Sodium bicarbonate $NaHCO_3$	To reduce viscosity	8.2
Carbonox		To reduce viscosity	
Tannex		To reduce viscosity	
Magcobar	Barium sulphate	Weighting material	

Source: Data supplied by oil operators and mud manufacturers.

COMPARATIVE DRILLING EQUIPMENT COSTS

(West Texas Experience)

	1947	1944	Per cent increase
By groups			
Derrick	$15,100	$12,100	24.8
Draw works	136,000	98,800	37.6
Derrick equipment	38,800	29,600	31.1
Cellar equipment	11,300	9,900	14.1
Rig up equipment	10,300	8,000	28.8
		(Avg)	33.5
By items			
Drill stem and pipe collars	73,400	38,800	89.1
Slush pump belts	832	674	23.4
Pumps	17,075	11,889	43.6
Engines	26,898	19,769	36.1
Suction hose	346	250	38.4
Light plant (20 H.P. engines)	2,380	1,892	25.8
Water unit	2,500	2,000	25.0
Crown block	4,728	3,231	46.3
Traveling block	6,293	4,536	38.7
Type B tongs	1,407	1,012	39.0
By items (contd.)			
Weight indicator	1,700	368	361.9
Cat line (Manila)	65	40	62.5
D. V. valve (6000 lb test)	3,334	2,520	32.3
Rotary hose	831	700	18.7
Operation			
Crew labor (day)	217	174	24.7
Compensation insurance	22	13	69.2
Trucking	930	829	12.2

SINCE 1940 PRICES HAVE ADVANCED

To March 1, 1948

Steel products	48.0
Lumber	178.2
All manufactured products	86.0
Hourly earnings of employees	118.0

Source: J. E. Warren, Carl B. King Drilling Company, and *The Petroleum Data Book* Research Department

UNITED STATES WILDCAT DRILLING

Year	Total wildcat wells drilled*	Wildcat oil producers	Per cent oil producers
1935	1,675	190	13.4
1936	1,950	215	10.3
1937	2,224	250	12.4
1938	2,638	260	9.9
1939	2,589	245	9.5
1940	3,038	300	9.9
1941	3,264	504	15.4
1942	3,045	408	13.4
1943	3,319	432	13.0
1944	3,848	493	12.8
1945	4,105	541	13.2
1946	4,615	639	13.8
1947 (P)	5,201	786	15.1
Total	41,511	5,259	12.7

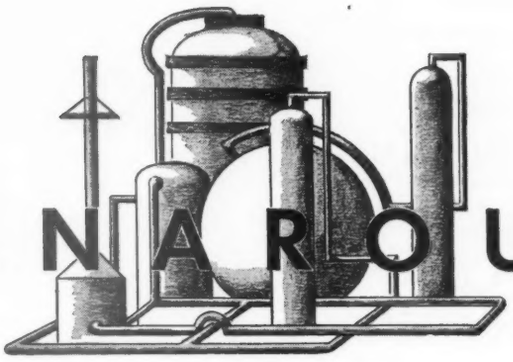
*Includes gas wells.

(P)–Preliminary estimates.

Source: *The Petroleum Engineer*, January, 1948.

From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.

THE TURNAROUND



The Power To Destroy

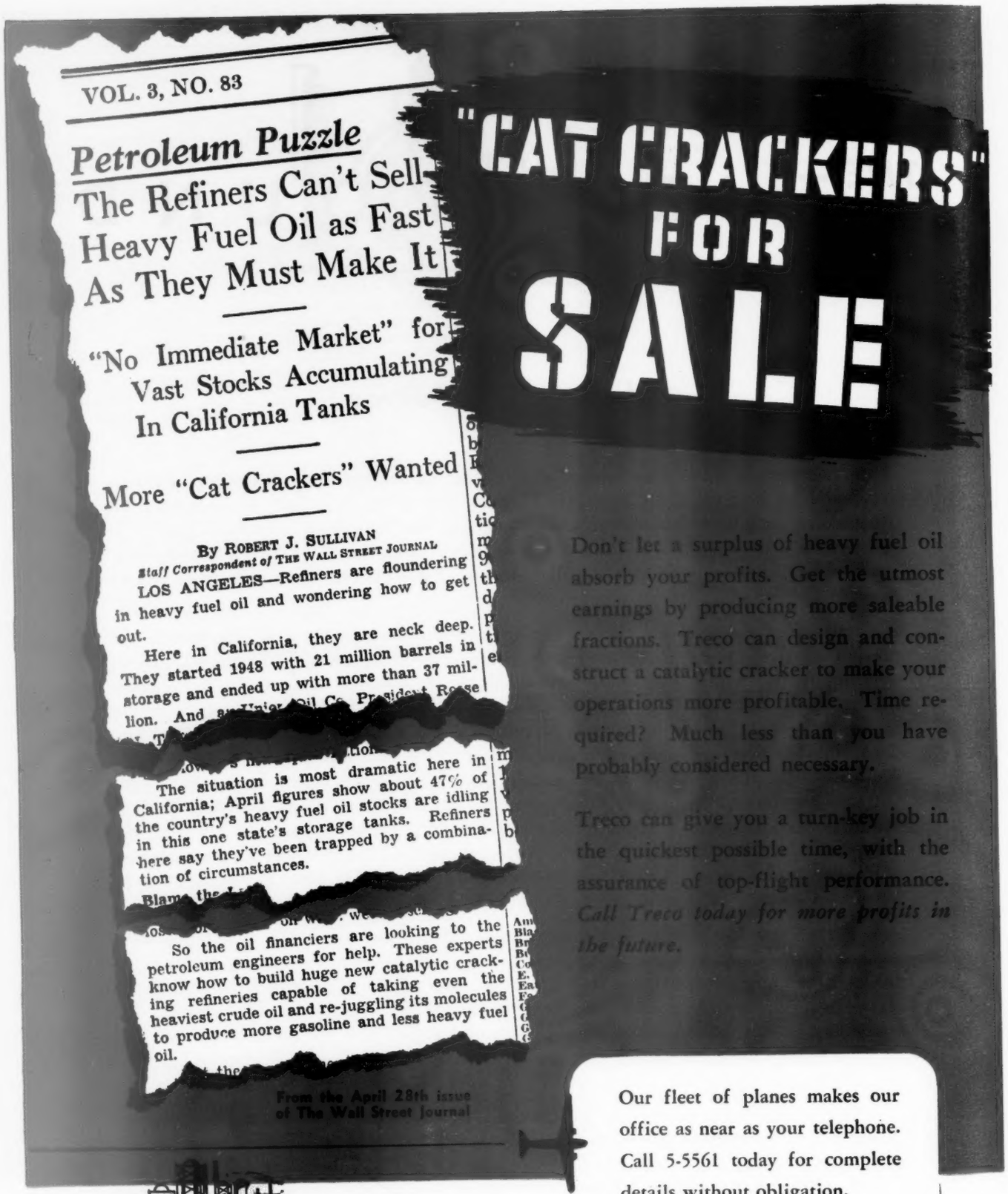
THIRTY-EIGHT of each one hundred dollars that an industrial company now earns is consumed by Federal taxes alone, so Happel and Aries point out in discussing the prospect of long-term investment money entering the American industrial field. The prospects are none too good. Even if the company gives out its profits in dividends to stockholders, the government will collect up to 77 per cent of these dollars as income taxes.

Heavier taxation is not the answer to the drying stream of new enterprises. Our present relatively high rate of unemployment can be absorbed and eliminated only by new enterprise, which will come only if risks are covered reasonably by possible returns to the investor. High rates of taxation and excessive inflation costs are drying up venture capital since the margin of return is too small to maintain the flow. Less than 400,000 new firms started operation last year; in 1946 600,000 new business ventures began. Last year 300,000 ventures shut up shop, leaving a new gain of only 100,000 new enterprises. Cancellation of many large projects by the industry, to avoid excessive building and operating costs is commonly known. Stanolind Oil and Gas Company cancelled the huge synthetic plant scheduled for southwest Kansas, because of steadily and seriously mounting costs, and at least a score of other important projects have been shelved or abandoned for the same reasons.

For an industry that has spent more than 1.5 billion dollars per year since war's end and that plans to spend a billion a year for the next five years, there is no prospect that investors will become timorous as long as some return is expectable, reasonably commensurate with the chance of losing the investment. The industry has introduced new products at the average rate of one per day for the last quarter of a century, and in the right sort of business or governmental "climate" it can be expected to continue producing.

One of the ways by which this industry can conserve is to build less overload capacity into its plants. This is on the basis that the last dollar invested must be able to bring in a satisfactory return. Therefore extras and auxiliaries will be fewer and cost less. Yet, there is a limit to what the engineer can do to extend the coverage of our needs by the investor's dollars. Taxes must leave enough profit to induce investors to risk their money. The engineer and chemist cannot make petroleum products without improving their units periodically, calling for investment and reinvestment.

Arch L. Foster


VOL. 3, NO. 83
Petroleum Puzzle
The Refiners Can't Sell Heavy Fuel Oil as Fast As They Must Make It
"No Immediate Market" for Vast Stocks Accumulating In California Tanks
More "Cat Crackers" Wanted
By ROBERT J. SULLIVAN
Staff Correspondent of THE WALL STREET JOURNAL
LOS ANGELES—Refiners are floundering in heavy fuel oil and wondering how to get out.
Here in California, they are neck deep. They started 1948 with 21 million barrels in storage and ended up with more than 37 million.
The situation is most dramatic here in California; April figures show about 47% of the country's heavy fuel oil stocks are idling in this one state's storage tanks. Refiners here say they've been trapped by a combination of circumstances.
So the oil financiers are looking to the petroleum engineers for help. These experts know how to build huge new catalytic cracking refineries capable of taking even the heaviest crude oil and re-juggling its molecules to produce more gasoline and less heavy fuel oil.
From the April 28th issue of The Wall Street Journal
"CAT CRACKERS" FOR SALE
Don't let a surplus of heavy fuel oil absorb your profits. Get the utmost earnings by producing more saleable fractions. Treco can design and construct a catalytic cracker to make your operations more profitable. Time required? Much less than you have probably considered necessary.
Treco can give you a turn-key job in the quickest possible time, with the assurance of top-flight performance. Call Treco today for more profits in the future.
Our fleet of planes makes our office as near as your telephone. Call 5-5561 today for complete details without obligation.
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Research Engineer Primo Pinotti runs Geiger counter test.

Radioactive Tracers Used in Research on Engine Wear†

P. L. PINOTTI*, D. E. HULL*, and E. J. McLAUGHLIN*

Radioactive tracers have been used successfully in developing an improved method for determining engine wear. The technique and results shown in this paper are an example of the application of radioactive materials in engine and petroleum product research. Other important uses are evident. For example, it is well adapted to the investigation of engine operating conditions such as speed, load, oil temperature, jacket temperature, air fuel ratio, and other variables. Similarly, the critical parts of transmissions, differentials, steering mechanisms, and other parts can be evaluated under a variety of operating conditions.

THE influence of fuels and lubricants on engine wear is important yet engine wear as affected by these products is a subject on which we generally have had inadequate data. Engine wear tests using previously available methods have been slow, costly, and difficult to conduct with precision. Accordingly, the California Research Corporation initiated development of a better procedure and, after considering a number of possibilities, concluded that an attractive method was the use of radioactive tracers in some of the engine parts most subject to wear. The development of our technique was made possible by the Isotopes Division of the Atomic Energy Commission, by making available for research radioactive isotopes produced in the uranium chain-reacting pile. Through their cooperation, cast iron piston rings were made radioactive by subjecting them to irradiation in the pile at Oak Ridge, Tennessee.

The usual practice in conducting wear tests is to assemble the test engine with new or cleaned pistons, rings, cylinder liners, and bearings after these parts have been carefully weighed and measured. The engine is then operated for an extended period and dismantled for inspection, which includes visual observation and rating, measuring, weighing, and photographing. In some instances the engine is dismantled several times during the test run to provide additional inspections but several hundred hours of operation is usually required to obtain the desired accuracy. This type of test has the following disadvantages:

1. It is slow and expensive because of the length of the test, the large number of new parts required for each run, and the time required for each assembly and disassembly of the engine.

2. The intermediate disassembly of the engine sometimes causes erratic results because of inability to reassemble the test engine in exactly the same manner each time.

3. It cannot be used for study of transient effects because the method is not very sensitive and usually a minimum of 50 to 100 hours operation is required before significant wear can be determined.

4. Results are influenced by the surface finish of the parts used in successive tests and when new parts are used variations in these parts greatly affect precision.

The wear test method based on the increase in iron content of the lubricating oil as determined by chemical analysis also merits consideration. This method is attractive and is frequently used in conjunction with the conventional wear test procedure described above, but it also has certain disadvantages:

1. The shortest operating period for measurable wear determination with the iron analysis method is about 25 to 50 hours.

2. The iron analysis method indicates total engine wear and it is not possible to isolate the wear of a given engine part without dismantling the engine.

3. There is unavoidable delay in obtaining the iron analyses. While this is not the major drawback in practice, it is usually at least 24 hours before a test engineer can obtain the completed analysis from the chemical laboratory.

The method we have developed measures wear by determining with a

†Presented before Society of Automotive Engineers, Detroit, Michigan, January 10-14, 1949.

*California Research Corporation, Richmond, California.

Chemist Don E. Hull lifts radioactive piston ring from its storage place. Long stick holds ring away from his body, thus decreasing effect of rays emanating from metal.

Hull tests radioactivity of ring before running a test. Arrow on gauge indicates how hot the ring is.

Geiger counter the amount of radioactive metal removed from the engine part under study and present in the lubricating oil. In our work, the top compression ring was selected for the initial study because the condition of this part of the engine has an important influence on engine operation, and also because the wear on the cylinder wall is usually a function of wear of the top ring.

To provide radioactive rings, ordinary cast iron piston rings are irradiated in the atomic pile at the Atomic Energy Commission's Oak Ridge National Laboratory. As a result of nuclear bombardment, a small fraction (about one in a billion) of the iron atoms in the piston ring is made radioactive. These iron atoms absorb neutrons and are changed thereby to atoms of a heavier iron isotope. This heavier isotope of iron is almost identical with the original iron in all properties except radioactivity. The heavier iron atoms emit beta and gamma rays spontaneously in the process of radioactive disintegration. This process, like other radioactive decompositions, goes on at a rate independent of temperature and of any physical or chemical treatment to which the metal may be subjected. The gamma rays activate the Geiger counter and signal the presence of extremely minute quantities, as little as one part per ten million, of iron in the oil from the radioactive engine part.

The radioactive iron atoms disintegrate at a rate such that half of them will have disintegrated after 47 days; this isotope of iron is therefore said to have a "half life" of 47 days. Besides the heavier isotope, a lighter radioactive isotope of iron having a half life of four years is also formed in smaller proportions. Also, if the ring contains other metals, the over-all decay rate will be influenced by the amount of radioactive elements formed in such alloying components. The actual half life of the radioactive piston rings, as shown on Chart 1, was found to be 52 days.

FIG. 1. Rate of decay in radioactivity of standard iron sample.

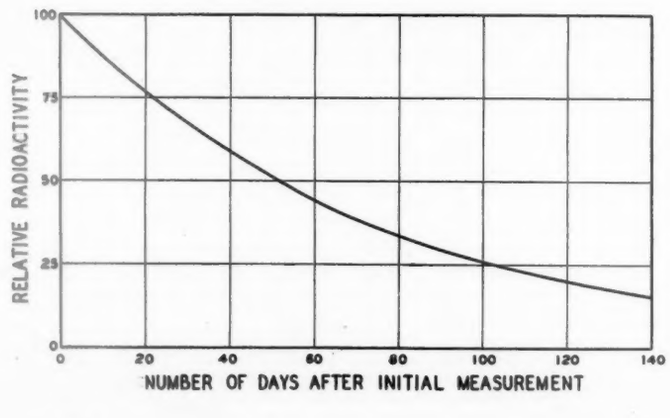
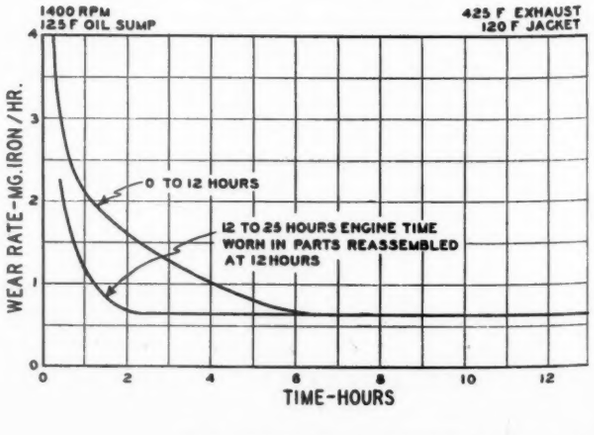
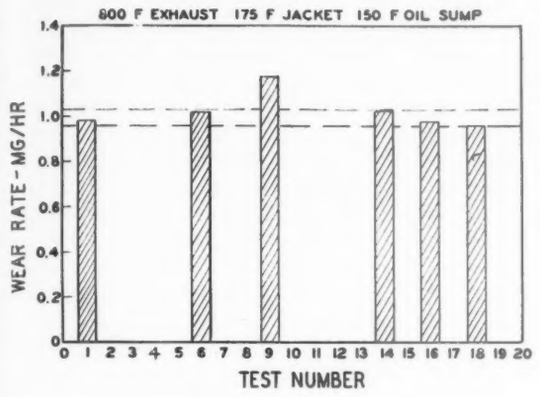


FIG. 2. Wear rate of piston rings during break-in.
Single cylinder 4-cycle diesel engine, 4¼-in. bore.





NOTE: Both Figs. 3 and 4 represent a single cylinder 4-cycle diesel engine with a 4¼-in. bore.

FIG. 3. Reproducibility of reference tests.

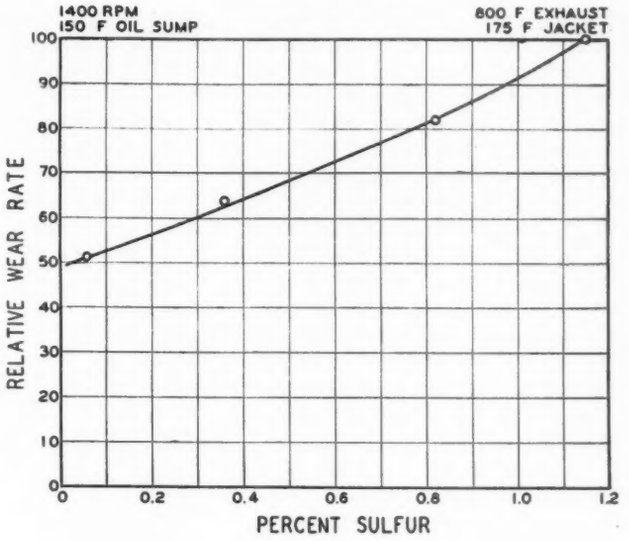


FIG. 4. Relation between fuel sulphur content and ring wear.

It is particularly significant with respect to this test procedure that the irradiated rings are of uniform radioactive composition throughout each ring and also from one ring to another in a group irradiated at one time.

Wear Test Method

A standard cast iron piston ring which has been irradiated in a pile at Oak Ridge is installed in the top ring groove. After a short period of break-in to establish uniform conditions, the procedure consists of the following steps:

1. The crankcase is flushed and filled with a charge of fresh oil.
2. The activity of the fresh oil is measured before the engine is started. This measure of activity is used in the correction for "background" activity or the activity which exists (in the vicinity of the measurements) due to natural sources such as cosmic rays.
3. The engine is then operated under the desired test conditions.
4. Oil samples are taken at intervals and the radiation activity level measured by immersing the Geiger counter in the oil sample for a few minutes.
5. As soon as the activity measurement is completed, the oil sample is returned to the engine crankcase so that the overall activity level will not be influenced by a change in total oil quantity and so that all of the oil will have a uniform radioactivity level before the next sample is taken.
6. The radioactivity level of the oil varies directly with the amount and specific activity of the activated iron present in the oil, so the amount of iron worn from the ring may be readily calculated.

This procedure was developed on a standard single-cylinder, 4¼-in. bore, 4-cycle diesel engine.

Our method, licensed under Patent No. 2,315,845 (Ferris, Atlantic Refining Company), takes advantage of the extremely high intensity of the neutron flux of the uranium pile, which has only recently become available.

Safety Precautions

Certain precautions should be taken for the protection of operating personnel in conducting a test of this type. According to Lapp and Andrews, "Nuclear Radiation Physics," 100 milliroentgens per day is the maximum safe daily exposure from a health standpoint. The roentgen is a quantitative measure of the radiation exposure, one roentgen being the quantity of ionizing radiation which will dissipate 83 ergs in ionization per gram of body tissue. The one-tenth of a roentgen, or 100 milliroentgen safe level mentioned above, is the maximum total activity which any individual worker should absorb in an eight-hour period.

In our work, the strongest source of radiation is the rings themselves. These rings are stored and shipped in a 300-pound lead box. The highest surface radiation level measured on this box when it contains a full set of freshly irradiated rings is about 7 milliroentgens per hour so that even if one person were to be in contact with the box for a full eight-hour period, his maximum exposure would be only 56 milliroentgens or about half the safe tolerance level.

In installing or removing the rings, they are never touched by hand but are handled with a set of long tongs or tools. Assembly and disassembly of the engine is carefully planned so that the work may be accomplished in the minimum time. By taking the proper precautions, the mechanic who assembles the engine with the irradiated ring receives a total exposure, in a period of one to two hours, well within the safe limits. Also, all personnel working in the "isolation ward" or portion of the laboratory assigned to engines on this project, are required to wear radiation exposure meters.

Test Results

In establishing the method, a set of tests was devoted to obtaining a material balance on the iron loss of the ring as indicated by the radioactivity of the oil and compared to the actual ring weight loss. The material balances obtained at 12 and 55 operating hours are shown below:

Material balance on piston ring

12 Hours		55 Hours	
Calculated from Radioactive Meas.	Weight Loss	Calculated from Radioactive Meas.	Weight Loss
24.6	25.0	37.2	38.0

Iron worn from ring (mg)

In making the material balance, it was assumed that the oil going past the rings contained the same iron concentration as that contained in the oil sump at time oil was burned.

It is of interest that about 25 per cent of the iron worn from the rings

during the first twelve hours' operation settled out of the lubricating oil and was removed by flushing the engine, while less than half of one per cent was retained in the engine at the end of fifty-five hours' operation. This would indicate that during the first few hours' operation, iron particles large enough in size to settle out of the lubricating oil are abraded from the rings. After the rings have worn in, however, the wear levels off at a normal rate and the iron worn from the ring remains in the lubricating oil.

This effect of break-in wear is shown in Fig. 2. These data show that the wear rate is high during the start of break-in, drops gradually and levels out to a constant wear rate after about six hours' operation. This break-in effect was also observed upon reassembly of worn-in parts (Fig. 2). After reassembly, the ring wear leveled out to a constant wear rate at the end of about two hours' operation. It should be emphasized that conditions in the engine are not constant during the break-in period and a steady state must be established before comparative testing can be started. After break-in, however, a comparative test result can be obtained in about two hours.

Fig. 3 presents the wear rates as obtained in six reference tests during a series of nineteen successive wear tests in the single cylinder, 4-cycle diesel engine. The excellent reproducibility possible with this type of wear test is demonstrated by the narrow band which covers five of the six reference tests. The one reference test which does not fall in this band (Test No. 9) was influenced by a deviation in test operating conditions.

Effects of engine operating conditions on wear rate in the single cylinder 4¼-in. bore engine are illustrated in the following table:

Jacket Tem. F	Load, %	Wear rate Mg. iron/hour
180	100	0.48
125	100	0.83
125	40	0.45

It will be noted that decreasing the jacket temperature increased wear substantially. Also, for the higher wear condition, decreasing the engine output reduced wear. These results indicate the ease with which a complete picture of the effect of operating conditions on wear rate can be obtained for a particular engine.

The wear rates obtained with compounded and uncompounded lubricating oils were investigated. Typical results are as follows:

	Wear rate Mg. iron/hr.
Uncompounded oil	1.81
Heavy duty oil meeting army ordnance 2-104B Spec.	1.06
Heavy duty oil meeting Caterpillar Tractor series 2 requirements	0.65

It is of interest to note that for heavy duty service the wear rate of piston rings as measured by this test method is markedly reduced with superior oils as has already been proven by extensive laboratory and field tests.

The effect of fuel sulphur content has been of concern to both the engine builder and petroleum refiner. This effect has been studied by many investigators, notably Cloud and Blackwood, Rosen and Blanc, Moore and Kent, and others. Using our newly developed test method, the effect of fuel sulphur on ring wear under specified operating conditions in one engine was determined in one day. These data (as shown in Fig. 4) indicate consistent increase in wear rate with increased sulphur content in agreement with published information. Means for reducing and controlling such wear have been developed by the automotive and petroleum industries, and the use of proper lubricating oil has been established as a major factor in keeping engine wear within reasonable limits under all heavy duty service conditions.

The authors would like to express appreciation to the Isotopes Division of the Atomic Energy Commission for their very willing assistance and for activating the piston rings used in these tests.

* * *

Oil Refinery Aids in French Industrial Recovery

AN OIL refinery, in full operation, is doing its bit to aid an industrial region in the French war zone, in its struggle to lift itself up out of the rubble and destruction left by American bombers during World War II. In a rural setting the industrial region stretches from Nantes to St. Nazaire at the mouth of the Loire river, in France. Harold Callender, former Oklahoman, tells the story in the New York Times.

On the long waterfront and in the industrial areas and shipyards little destruction is now visible. The presence of large ships in operation or under construction, the oil refinery, tin plate factory, locomotive works and chemical plants offer signs of reviving industry.

But the story is different in the towns that in the early spring were under German occupation. There the destruction is more evident than the restoration. Gaping holes, and huge gaps in the medieval masonry in Nantes tell the story of Allied bombing more vividly than words portray.

According to official figures 2,372 buildings were totally destroyed and 10,623 were damaged to a greater or less extent; about 2,000 persons were killed and some 3,000 injured. And, as in most stories eminating out of the war, a note of irony creeps in. A Flying Fortress too high for accuracy, a missed target, a city destroyed, needlessly. That's the local version. Rightly or wrongly, and subject to the testimony of the United States Strategic Command, the American forces are blamed for this civilian destruction that is recorded as having taken place on September 16 and September, 1943—an old story but one not easily nor soon forgotten.

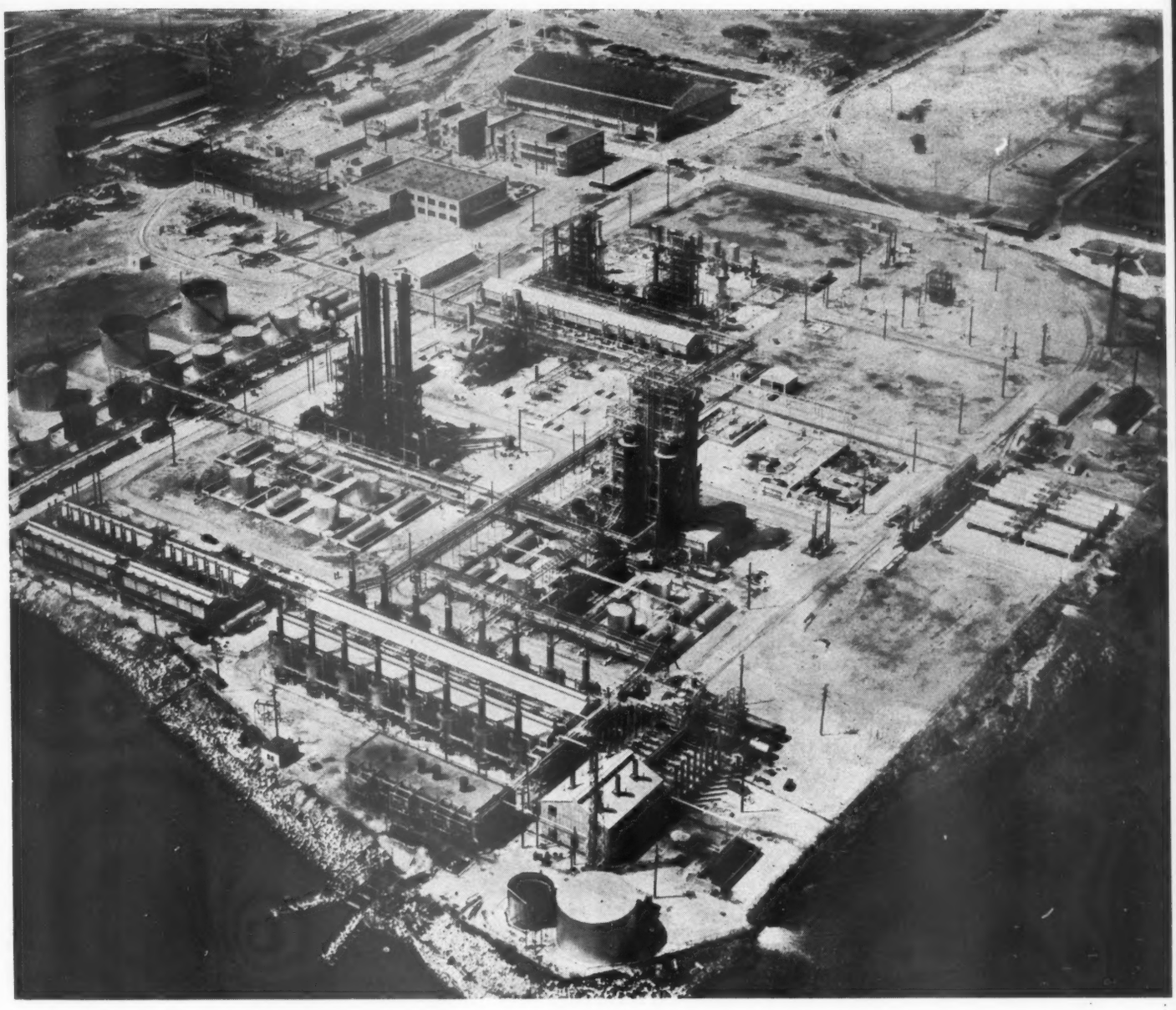
Most citizens of Nantes now seem to take a philosophical view of the tragedy. It is mentioned here because it is a pertinent part of the recent history of this region and of its recovery.

Comparatively little is left of St. Nazaire, a town of 37,000, with its adjoining shipyards that served as a German submarine base. Repeated attacks by air and sea have flattened the little town, until the rubble far exceeds the surviving buildings.

Something like a fourth of St. Nazaire's population is estimated to have been rehoused, mostly in temporary huts. Their homes were scattered like leaves in the wind when the bombs began falling. But the bulk of the 12,000 shipyard workers must now dwell in other towns and spend much of their time travelling to and from the job, and precious time is lost.

The shipyards at Nantes and St. Nazaire have been re-equipped and are now building vessels, but many wonder how many of the 12,000 at St. Nazaire will be employed after the new *Ill de France* is finished in July and the reconditioning of the former German liner *Europa* is done next year.

Fertilizer plants transforming phosphates have slowed down because the farmers have gone on a buying strike. The coal shipments from the United States, which have employed dockers and which made up more than half of the incoming freight of the port of Nantes and St. Nazaire in 1948, are expected to diminish as European coal becomes more and more available.



Reconstructed Texas City styrene plant of Monsanto Chemical Company two years after explosion.

Styrene Plant Rises From Its Ashes

ARCH L. FOSTER*

NOTHING in modern times could be more emblematical of the fabled phoenix than the newly reconstructed styrene synthesizing plant of Monsanto Chemical Company at Texas City, Texas, which resumed operations in March of 1948. The original plant was blasted into rubble by the explosion of 2300 tons of ammonium nitrate, synthesized in southwestern plants from natural gas and atmospheric nitrogen, when being loaded into the steamship *Grandcamp*, at a nearby dock. One of the more unfortunate factors is that the material that destroyed the Monsanto plant, the docks, and killed 145 plant employes, is not produced at the Monsanto plant at all; the plant was merely an "innocent bystander" and by far the largest loser in the catastrophe. The $17 million insurance payment is the largest on record, it is reported.

EXCLUSIVE

The new plant is essentially the same as that destroyed in the holocaust, which came without warning. The original plant was built and operated by Monsanto for the Rubber Reserve Corporaton in 1943 as part of the herculean project of supplying

*Editor, Refining and Gas Processing.

H. H. Davis looks over the reconstructed Monsanto plant. In foreground is compressor house with ethylene purification towers immediately behind. Also visibile, left to right, is the store room, research laboratories, office building, and shops.

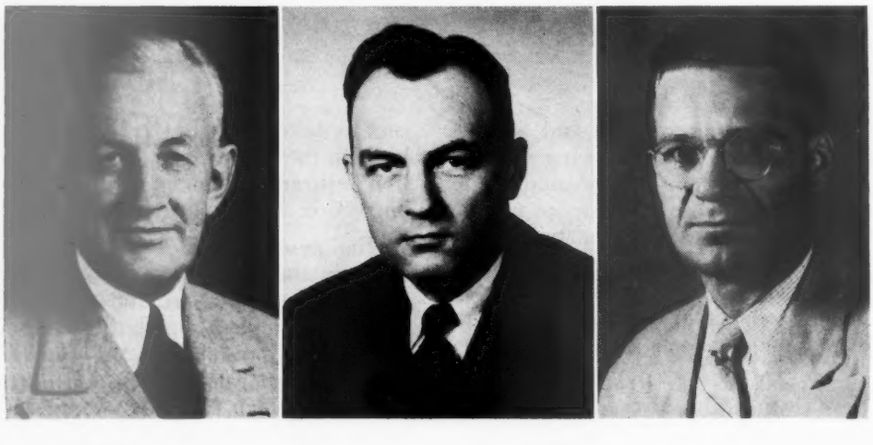
our rubber needs from synthetic sources. Its rated capacity then was 72,000 tons of styrene monomer per year. This represented 25 per cent of our total styrene requirements under the plan in effect at that time; less than 300,000 tons of this product was needed to produce the required rubber needs of the country and its armed forces. By combining styrene, one part, with butadiene, three parts (approximately), and along with carbon black, plasticizers, softeners, and other "modifiers" synthetic rubber is formed for tires and many other purposes. Butadiene and a part of the styrene material are derived from petroleum and/or natural gas hydrocarbons, as will be shown below.

The old plant was bought from the government in October, 1946, for $9,550,000. It was destroyed April 16, 1947. The actual site of the plant was then moved eastward a few hundred feet, to clear the tangled mass of wreckage, which later was cleared away for the most part. Production of ethylene was begun again in March 1948, 11 months after the disaster; the plant started shipping styrene monomer the following August. (The term 'monomer' refers to the product still in single-molecule condition; a large number of molecules combine to form the styrene polymer, a plastic solid discussed later in this article).

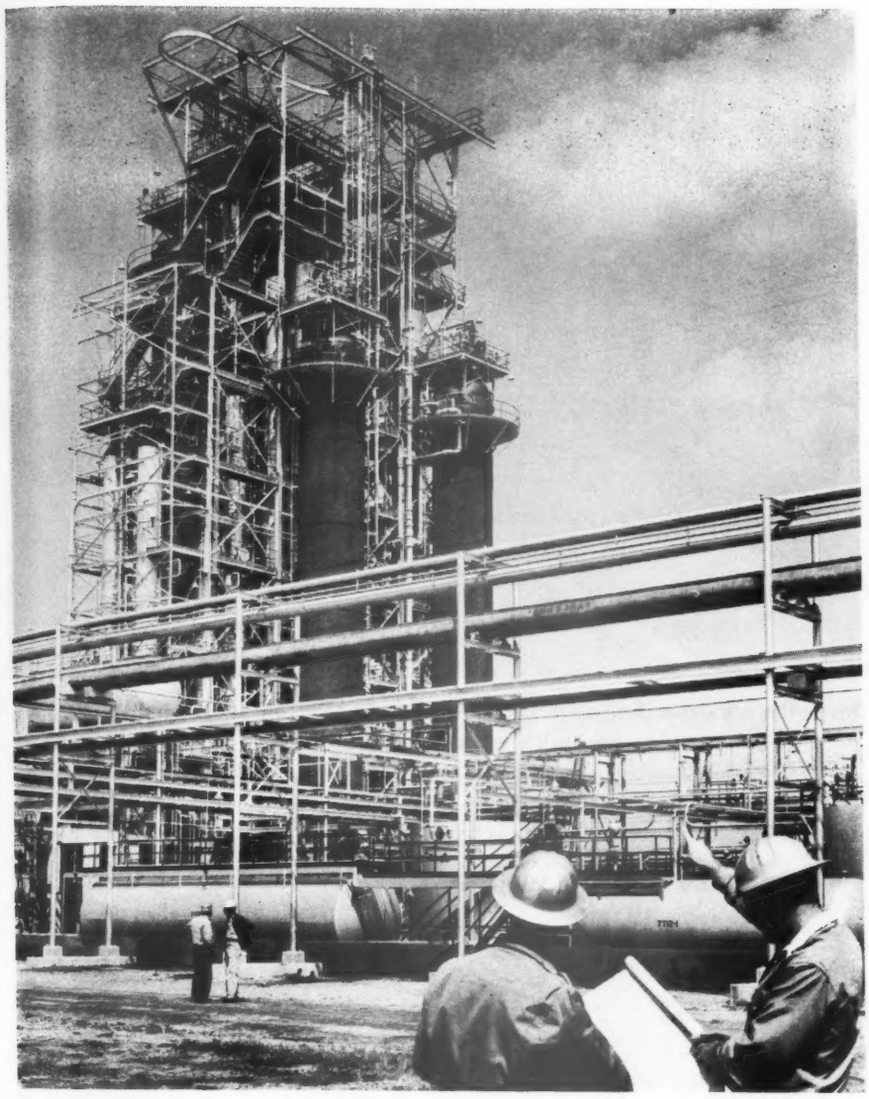
William M. Rand
President, Monsanto Chemical Company

J. R. Mares
Vice President and General Manager

H. K. Eckert
Plant Manager



The synthesis of styrene is a relatively well known series of chemical reactions. Nitration grade benzene, normally shipped into the plant by tanker or tank car is alkylated by ethylene, $CH_2{=}CH_2$ to form ethylbenzene, $C_6H_5{-}CH_2{-}CH_3$. The ethylene is prepared by cracking propane, C_3H_8, to yield the olefin. Lastly the ethylbenzene is dehydrogenated selectively with a catalyst, probably a metallic oxide or mixture of oxide, at elevated temperatures to form styrene, or phenylethylene, $C_6H_5\ CH_2{=}CH_2$. The chemical reactions involved are as follows, disregarding side reactions that form undesired byproducts.



This distillation structure rises 230 ft above the Texas prairie at Monsanto's reconstructed Texas City plant. The towers are used to purify styrene monomer. The men in the foreground are W. L. Dyer and O. J. Marchand.

$$CH_3—CH_2—CH_3 + (\text{heat}) \rightarrow CH_2=CH_2 + C + 2H_2 \quad (1)$$

Propane → Ethylene (catalyst: $AlCl_3$)

$$C_6H_6 + CH_2=CH_2 \rightarrow C_6H_5—CH_2—CH_3 \quad (2)$$

Benzene → Ethylbenzene.

$$C_6H_5—CH_2—CH_3 + (\text{Heat}) \rightarrow C_6H_5—CH=CH_2 \quad (3)$$

Styrene.

The alkylation of benzene with ethylene is carried out by the well known Friedel & Crafts reaction, using aluminum chloride as catalyst, promoted by the presence of hydrochloric acid, HCl; this reaction is used widely in the chemical and petroleum industries, being applicable with variations in detail to several reactions of scientific and industrial importance.

The styrene so produced is a colorless liquid with a mild odor, boils at 146 C (294.8 F) and with specific gravity of 0.905 @ 20 C. Since slight variations in composition and the presence of impurities affect its properties seriously in many cases, it is made in high purity. This is affected by purifying carefully the intermediates ethylene and benzene—the latter nitration grade, the purest industrial form of benzene after the C.P. grade—and by similarly purifying the raw styrene product by distillation, etc. Its final purity is 99.7 per cent plus. Purification of ethylene gas, made from propane of 95-plus per cent C_3H_8, is a two-step procedure, first by high-pressure absorption and stripping, as with activated carbon—the Hypersorption Process is one example of this system—followed by high pressure distillation to eliminate impurities boiling near the same temperature as does ethylene.

Styrene polymerizes to form its clear light-weight colorless plastic, called thermoplastic since it can be softened and formed under heat. It is molded by pressure injection into molds into innumerable items of commercial and industrial products, toilet articles, machine parts, electrical fixtures—it has high dielectric strength—cabinets, etc. Its main use is in the monomeric or unpolymerized liquid form to make synthetic rubber. Polystyrene is made by Monsanto under the trade name of Lustrex, in the company's Springfield, Massachusetts, plant.

In addition to the cracking, alkylating, dehydrogenating, and purifying units indicated by the preceding resume the plant has installed and uses six Marine type steam boilers, along with 16 oil field type boilers. The Combustion Engineering Marine boilers have capacity of 30,000 lb of steam per hour each; four of the Donovan oil field boilers each has 8000 lb per hour capacity, 12 can make 6000 lb per hour. All produce steam at 210 psig; some process steam is obtained as the exhaust from the steam turbine-driven salt water pumps. Exhaust steam is condensed to feed the Marine boilers, any excess condensate passing to the other boilers. Fresh well water is treated with 98 per cent sulphuric acid to break up the bicarbonate (Calcium, alkali, etc.) and the pH is then balanced with the required amount of 25 per cent caustic soda solution. Three wells 625-ft deep supply water at 600 gpm; as a part of the fire protection plan a 202-ft water tank holds 100,000 gal in reserve; another reserve tank holds 500,000 gal. For cooling water the pumps take Galveston Bay water at 35,000 gpm. Chlorination and other treatments are provided as found necessary.

Fresh water is supplied by three pumps of 300 gpm capacity each; two are steam turbine driven, one powered by electric motor. Salt water is handled by 11 pumps, of 2500 to 10,000 gpm capacities; 9 are gas engine driven, 2 by steam turbines. Two Ingersoll-Rand and one Chicago Pneumatic compressors supply air at 350 to 450 cu ft per minute for all purposes.

Elaborate precautions are taken against fire, and for first aid and safety. All types of safety and protective clothing are provided. Fire protection is thorough and compre-

hensive. The following table shows the equipment and materials provided to guard against fire disaster.

TABLE 1. Fire-fighting equipment at Monsanto's Texas City styrene plant.

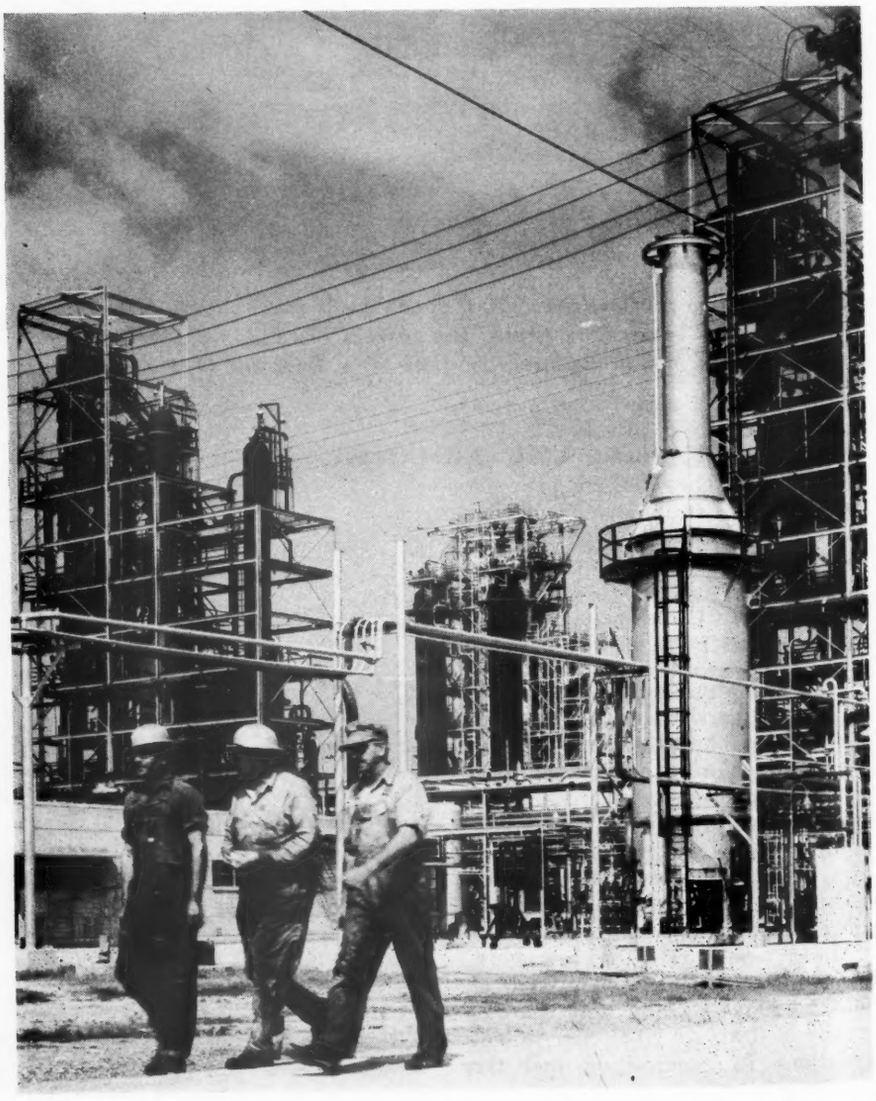
American-LaFrance fire truck, completely equipped, including 500 gpm, 400 psig pumping system, and complete liquid foam and fog systems
Trailer pumper, 500 gpm
21 high pressure hydrants (80–120 psig)
4 low pressure hydrants (65 psig)
7500 ft of 2½ in hose
1500 ft of 1½ in hose
19 hose houses
2—1000 gpm stationary pumps for 120 psig hydrants
500,000 gal water tank (for fire hydrants)
100,000 gal water tower (for sprinkler system)
2 foam houses, dry powder generation equipment, and distribution lines to storage tanks
Sprinkler systems in shops and stores building, research laboratory, and control laboratory
Gamewell fire alarm system
175 hand fire extinguishers distributed through plant

Since corrosion of equipment is a large factor in all tropical and subtropical locations, and the Monsanto plant is on the Gulf coast, the provisions to combat and reduce corrosion are of interest. For most of the equipment, piping, etc. in ordinary service plain carbon steel, 0.2-0.6 per cent carbon content, was employed. For salt water piping underground cast iron containing 3 per cent carbon, and with some silicon, nickel, manganese and phosphorus, was used to resist the very severe corrosive conditions. For salt water piping placed above ground wrought iron with 3 per cent slag content is found satisfactory, corrosive conditions being somewhat less severe.

Exchanger service is one of the most severe in a manufacturing plant, since two vapors or liquids are brought into contact with the metals; for salt water exchangers—where cooling is carried out by salt water exchanging with products—admiralty metal, 70 per cent copper, 30 per cent zinc, and cupro-nickel, 70 per cent copper and 30 per cent nickel tubes have been found adequate for most conditions.

For corrosive chemical services monel metal, which is essentially 70 per cent nickel and 30 per cent copper, is used as the cladding alloy in clad vessels which handle corrosive chemicals. Also vessels such as reactors, in very corrosive applications are lined with glass throughout; this is typical of the service in the alkylation reaction, in which benzene and ethylene

This is the ethylene purification control room at Monsanto Chemical Company's reconstructed plant at Texas City.



Ethylene unit was first to be rebuilt. Walking past purification towers are: W. W. Fulfor, Hady McGuire, and M. N. Crowston. In center background are stryene distillation towers.

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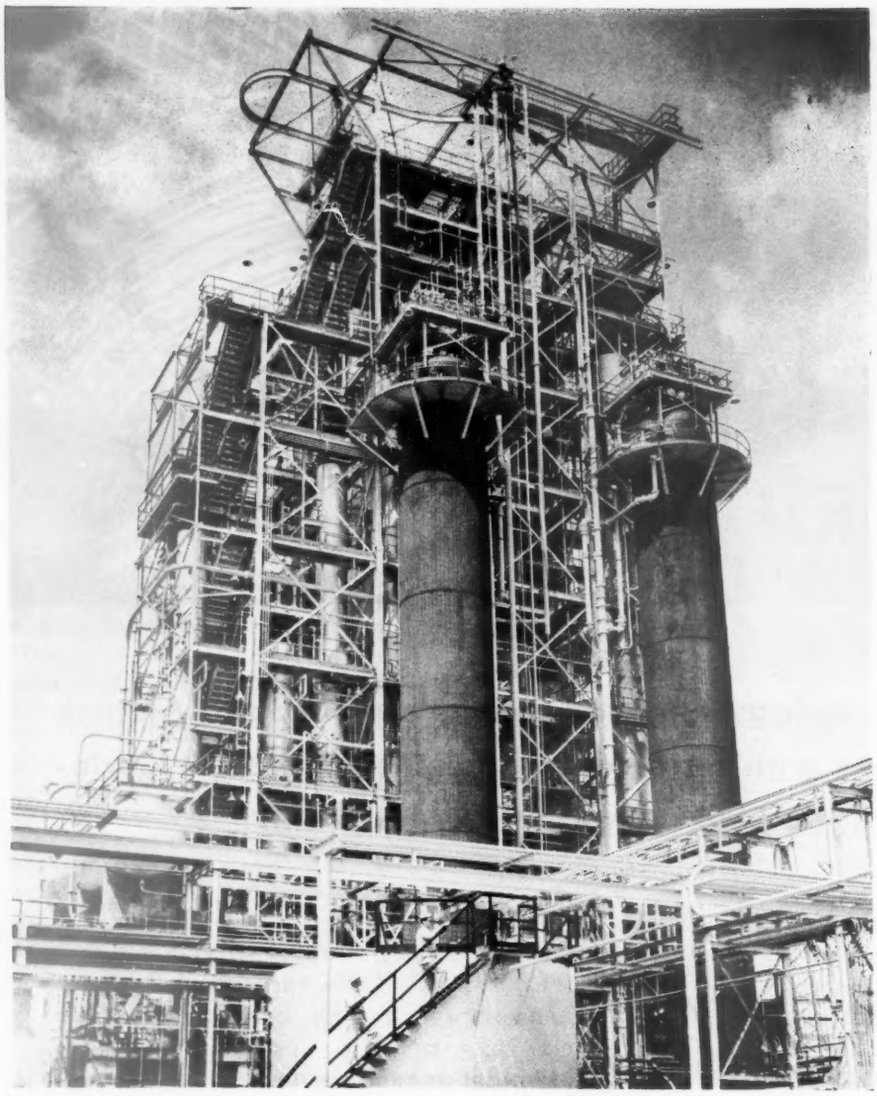
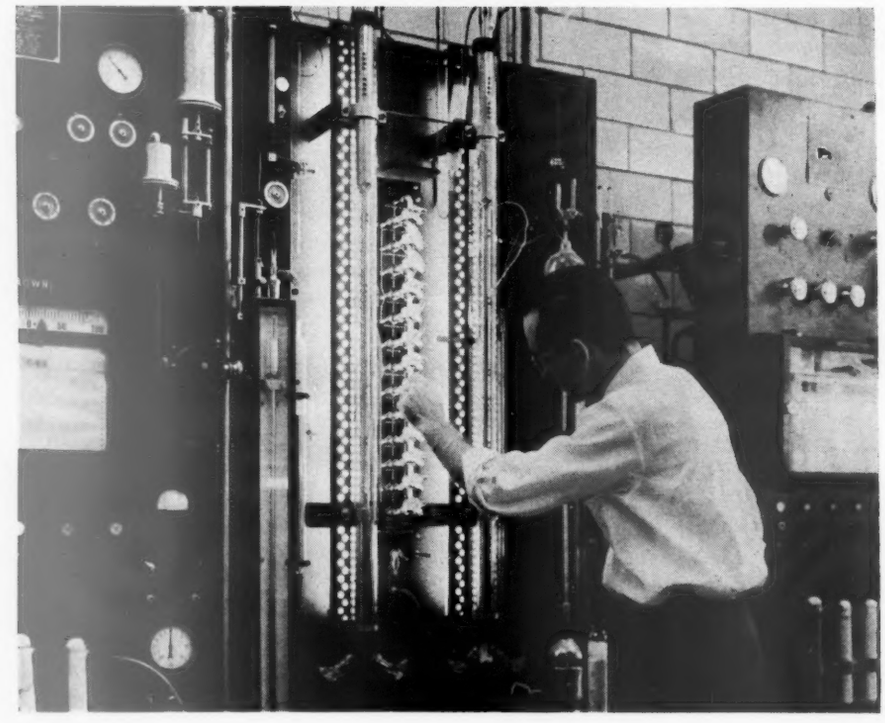


Stryene monomer is purified in these distillation towers. Men on the steps are J. E. Spillers, Jr., and I. L. Bryan.



Norman McCutcheon is shown here operating the Podbielniak machine. The "Pod" is used in the laboratory to determine components of hydrocarbon gases.

gas are brought into contact in the presence of the very corrosive catalyst $AlCl_3$ and its promoter HCl. Copper tubing is used on all instrument air lines.

Monsanto's Growth

Founded in 1901 by John Francis Queeny, at St. Louis, Missouri, Monsanto Chemical Company first made saccharin, the synthetic sulphuric acid derivative used widely as a sweetening agent, in place of sugar (sucrose) since it is not a carbohydrate. Successively the company expanded to produce such industrial and commercial materials as coumarin, glycerophosphates, caffeine form coffee, tea, etc.; vanillin, synthetic substitute for vanilla flavoring extract; phenolphthalein, chemical indicator and component of laxative medicines; acetanilide and phenacetin, chemically related febrifuges or headache remedies, and numerous other products.

During the early years Germany's chemical industry, so far advanced then beyond that of any other country, dominated world production and trade in especially organic chemicals. The troubles arising from World War I, which shut off most foreign sources of raw materials and intermediates, proved a blessing in disguise for Monsanto, since it was imperative that the company develop other independent sources. After that war ended, advances were made in the production of phenol, benzoic acid, phthalic anhydride, and many others, both in the USA and abroad, especially in England.

During World War II Monsanto operated 9 plants for the government. Most outstanding of its accomplishments was the operation of the Clinton Laboratories, part of the assembly of operations at the Oak Ridge, Tennessee, atomic energy establishment. This laboratory is still under Monsanto control and operation, a contract for this plan having been made with the U. S. Atomic Energy Commission in 1947. Monsanto also has built another atomic energy plant near Dayton, Ohio, and is building one currently at Marion, Ohio.

At present Monsanto and its subsidiaries are operating a total of 23 plants making a wide variety of chemicals, situated in America, England, Wales, Quebec, British Columbia, and Australia. ***

Applying Foresight to Problems of Engine Operation

•

Ethyl predicts the performance of fuels and lubricants used in engines operating in field service. This foresight is the foundation of Ethyl's "preventive service" designed to help refiners meet, with a minimum number of fuels and crankcase lubricants, the continually expanding use of gasoline engines, under a wider range of operating conditions.

Frequently, before experimental engines are put into production, the Laboratories subject them to exhaustive tests. If any incompatibility with petroleum products appears, modifications are made until successful results are achieved. Information so obtained is passed along to the engine manufacturers. All the wide variety of Ethyl's varied research facilities, including a cold room (right), are available for such work.

•

As a result of experience gained over more than 26 years, Ethyl Laboratories are able to evaluate petroleum products in respect to the results they may be expected to give in a wide variety of gasoline engines. The performance of many types of gasolines and lubricating oils is continuously observed. If any incompatibility of these products with engines in production is noticed, the results are passed along to the oil companies.

•

Many members of the Ethyl Laboratories are authorities on engine-fuel relationships and are always available to engineers of automotive companies for consultation in connection with research programs conducted in their own laboratories. Likewise, Ethyl technologists are glad to discuss with the technical people of oil companies the performance of their products as it is revealed in research programs and in field service.

•

Occasionally operating problems develop in the field because of abnormal conditions which could not be anticipated during the design of the engines. When this happens, the Ethyl Laboratories, having the benefit of specific information supplied by the field organization, work closely with the oil and automotive companies concerned.

•

A further extension of Ethyl's work in the field is the maintenance of contact with the operators of truck, bus and passenger car fleets. Based on field observations and on special research work conducted in the Ethyl Laboratories, recommendations are made to engine users to assist them in obtaining the best engine performance and durability on the fuels and crankcase lubricants used.

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Storage Tanks Moved by Floating

Abstract. At a minimum of cost and of damage, five 55,000-bbl crude storage tanks were moved several hundred feet to new foundations by floating them through a canal system to the new site. Bulldozers and a dragline shovel are among the pieces of equipment used in the operation. Cleaning and sealing the lower sections of the tanks preceded the move. A lock-system was employed when moving a tank to a lower or higher level.

THE Catalytic Construction Company recently completed the moving of five 55,000-bbl storage tanks by floating them to new locations. This operation was done to clear the site for the Sun Oil Company's $18,000,000 refinery expansion in Toledo, Ohio. Each of the tanks were 114 ft in diam, 30 ft high and weighed approximately 200 tons. As shown in Table I, one of these tanks was moved 1510 ft in a 4,250,000-gal canal.

The method of moving these tanks, by floating in a prepared canal, was chosen because it was both less expensive and less damaging to the tanks than either dismantling the tanks or skidding them. The moving of the tanks was broken down into the following four operations.

1. Preparing the tank, the new foundations, and the dikes.
2. The transportation.
3. The orienting and setting of the tank.
4. The disposal of the water.

The tank was prepared for floating by emptying its contents, 'safing' it, and cleaning it thoroughly. Next the bottom was inspected for holes and these holes were plugged or welded shut. The clean-out door was then replaced and all connections in the bottom ring were closed with blind flanges, pipe caps, or welded, depending on the type of connection. This procedure made the tank water-tight up to the level required for floating. At this time three lugs were welded on the top of the bottom ring for attaching the towing cables.

The foundation for the new tank was made up of a clay base with a 3-in. crown in the center. Around half of the foundation away from the entrance for the tanks, 5 posts, for steadying the tank while it was being set, were set in the ground about 30 ft apart, forming about 120 deg of the circumference of the tank that is to be set. These posts are 8 in. by 8 in. (oak) and 8 ft long. The posts are set 5 ft in the ground, backfilled, and tamped solidly.

The canal for floating the tanks was laid out so that it would serve for the movement of all of the tanks with a minimum amount of rebuilding of the dikes. Although the tanks would float in 18 in. of water, the dikes were made several times this height in order to provide for clearance in high spots enroute and for minor changes in level. When a considerable change of grade was encountered, a lock arrangement was created by building a dike across the canal at the point at which there was the greatest change in grade. This method was adopted rather than raising the water level along the entire route because of the considerable amount of time required to pump the extra volume of water into the canal. When the tank is being moved to a lower grade, the dike was first built across the canal to a height sufficient to accommodate the water necessary to float the tank in the upper level. Earth for this dike is taken from the canal area when the dike is broken; it is not necessary to move the earth out of the canal.

The tank is then floated to the face of the dike and the dike is broken to permit the tank to settle to the lower level. When the dike is leveled off the tank may be floated into position. When it is necessary to move the tank up-grade, the tank is floated in the lower canal for the maximum distance and a dike built behind the tank of sufficient height to hold the water necessary to float the tank into position at the higher grade. During the period in which the dikes are broken, the tank is held firmly in place by cables.

Although it has been indicated that tanks of this size would float at 18 in., it was necessary to pump to a depth of approximately 24 in. in order to create enough buoyancy to free the tank from its old foundation. Before the tank is freed, however, 2 cables, running from the previously attached lugs are connected to bulldozers on either side of the canal, and these are used to pull the tank along the canal. The second bulldozer was used to

TABLE 1. Data on moving of tanks.

CAPACITY.....55,000 BBL
WEIGHT.....200 TONS
HEIGHT.....30 FT
DIAMETER.....114 FT
PUMPING CAPACITY.....60,000 GPH

Tank number	No. 150 (old 151)	No. 151 (old 150)	No. 152	No. 153	No. 154
Changes of grade	603.80 ft to 606.50 ft to 602.50 ft	606.50 ft to 606.50 ft to 602.50 ft	607.70 ft to 606.50 ft to 602.50 ft	606.75 ft to 606.50 ft to 602.50 ft	604.05 ft to 604.05 ft to 602.50 ft
Man hours	158	187	160	160	125
Moving time (hours)	8	8	8	8	8
Depth of water (inches minimum)	18 in.	18 in.	18 in.	18 in.	18 in.
Volume of water (millions of gallons)	2.27	4.25	4.27	4.27	2.24
Pumping time (hours)	40	72	72	72	40
Dirt in dikes (cubic yards)	2000	3100	2100	2100	800
Distance moved (feet)	920	1510	980	970	230

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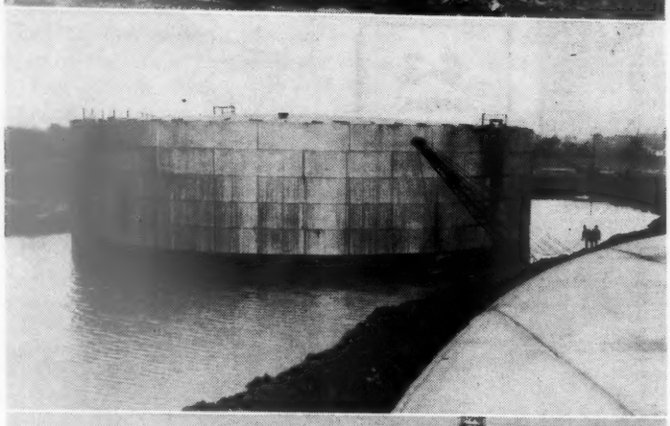
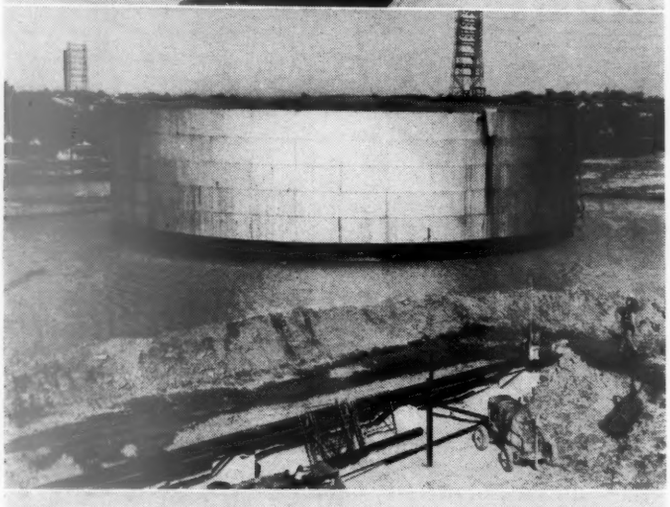
52-1

Breaking a dike to permit water in moving canal to flow into lower part of "lock" for transferring a tank to a lower level.



Tank is being floated "north" on first leg of trip to new resting place.



Already moved through one leg of journey tank is ready to be moved "west" to new foundations.

Finally tank has reached its new foundations and is ready to be lowered into position.

control the tank in moving rather than for power for under calm conditions the tank could be moved by several men. Sometimes it was necessary to place a third bulldozer in the pond to push or pull the tank over a high spot rather than risk damage to the tank by too great a pull by the bulldozer on the opposite sides of the canal. Under windy conditions, only one bulldozer on the windward side was required with another bulldozer in the canal pushing or pulling the tank. During the moving of the tank, one or more men were inside the vessel plugging leaks with wooden plugs. Also, a crew was watching constantly for leaks in the dikes and repairing those that occurred.

When the tank reached its new location, it was drawn into the semicircle of posts described above and held in place by three cables. To orient the tank properly, the following procedure was used. On a drawing of the tank and the new location three locating lines were run from fixed visible landmarks in the new tank area to the center of the tank and where these lines intersected the shell, a target was placed on the shell before the tank was moved. When the tank was about to be set, three transits were set up on the lines between the landmarks and the center of the tank and the tank was oriented by shifting it around until the proper targets were sighted on the vertical cross-hairs of the corresponding transits. The tank was moved into final position by slackening one and tightening the others, or revolved by a fourth cable, which partly circled the tank from one of the lugs attached for this purpose. When the tank was set, all lines were held taut before any water was released by breaking the dike.

The disposal of such a large volume of water creates a major problem because the uncontrolled flood can wash away the new foundation and undermine the existing foundations. The water should be discharged from the pond as slowly as can be allowed. A large ditch will control the water properly outside the pond because the major erosion occurs in the center of the ditch in a vertical direction.

The longest move of 1510 ft was accomplished in 8 hr actual moving time. This was preceded by 72 hr of pumping with pump capacity of 60,000 gallons per hour. The canal contained about 4,250,000 gal, and the move was accomplished with 187 man-hours. The tank was in as good condition on its new foundation as when it had been on the old, plus the advantage that the leaks in the bottom had been plugged and subsequently permanently fixed. ***

EXCLUSIVE

Microchemistry in Petroleum Industry

HARRY LEVIN*

FIG. 1. At their Beacon, New York research labs, Texaco scientists have found that as many as one hundred fractions can be obtained from a single drop of sample. Employing pipettes (above) smaller than a needle, drop-sized beakers, and balances packed to weigh almost nothing, the entire "lab" could be packed into an undersized overnight bag.

Many important test methods cannot be applied in the petroleum and other chemical industries because of extremely small samples of material. Microchemical methods have been developed over the years, permitting the microchemist to make several important determinations on a drop or two of material. Octane ratings may be made on a few milliliters of fuel; samples may be absorbed in woolen thread, too small to handle even in the vessels shown here. The author summarizes progress in this field, giving a new view of chemical research and analytical methods.

ALTHOUGH microchemical methods of analyses had been used to some extent by toxicologists prior to 1900, the real impetus which advanced this important field of chemistry was the great work by F. Emich and F. Pregl at Graz, Austria during the first decade of this century. Emich worked principally in the field of inorganic chemistry and Pregl's achievements were practically entirely in the field of organic chemistry.

Pregl was engaged in research on bile substances and was faced with the alternative of either abandoning the work for lack of sufficient material or developing micro procedures which would enable him to determine the composition and structure of the minute amounts of materials he had isolated from body substances after a tremendous amount of work. Encouraged by the achievements of Emich in the field of inorganic chemistry, Pregl decided to develop the necessary micro procedures and did so with such distinction that in 1923 he was awarded the Nobel Prize in Chemistry, the first time in history that this highest scientific distinction was conferred for the development of analytical methods.

This new technique made exceedingly slow progress in this country until 1925. At about that time J. B. Niederl and A. A. Benedetti-Pichler initiated a course in microchemistry at the Washington Square College of New York University and the application of these new methods was extended into many fields by their students. Industrially, the fields of biochemicals and pharamceuticals—because of the minute samples produced in research on many body and natural processes—were the principal users of these new methods. But as time went on it became evident that even the chemists in industries which measure their products in thousands and millions of barrels, can also use these new procedures to distinct advantage.

The petroleum industry, though slow initially to adopt and adapt microchemical methods to its problems, has for several years been applying these methods at an accelerated rate. That this industry is alert to the possibilities and is participating in the development, is evident from the fact that the Division of Petroleum Chemistry has devoted two full days to a symposium on microchemistry at the recent meeting of the American Chemical Society in San Francisco. Until but a few years ago it was a happy or unhappy "out"—depending upon the temperament of the investigator—too frequently to report "sample too small for analysis." There is little excuse for this today. Though it is impossible of course to make an empirical test on a few drops of sample when the empirical method specifies that a liter shall be used, it is amazing how often one skilled in microchemical methods can modify an existing method or develop an equivalent method which will yield, on a few drops of sample, information that can be expressed or interpreted in terms of results obtained with the larger quantity by the standard procedure.

Miscellaneous physicochemical measurements—some quite empirical—are of great importance to the petroleum industry because they are used for control of operations in manufacture and are included in customers' specifications. Macro methods are available, of course, but occasionally the available sample is too small and this generally happens when the case is particularly important. Micro modifications of these macro methods have often proven a godsend. At the recent American Chemical Society symposium, methods were described for gravity, viscosity, pour point, titer, vapor pressure and even the knock characteristics of motor fuels were obtained on a few milliliters of sample in an actual engine test. The oil content of wax, on a semimicro scale, is already a determination practiced widely and successfully.

At the San Francisco symposium there were described microchemical methods for determining sulphur, chlorine, bromine, oxygen, nitrogen, metals, and functional groups in oils and other products. Methods were given also for preparing hydrocarbons and other organic compounds in milligram quantities. Since the modern petroleum laboratory is concerned with highly chemical operations and processes, miscellaneous organic and inorganic materials either as byproducts of its own manufacture or items of purchase relating to its plant operations, these microchemical procedures, both analytical and synthetic,

*The Texas Company.

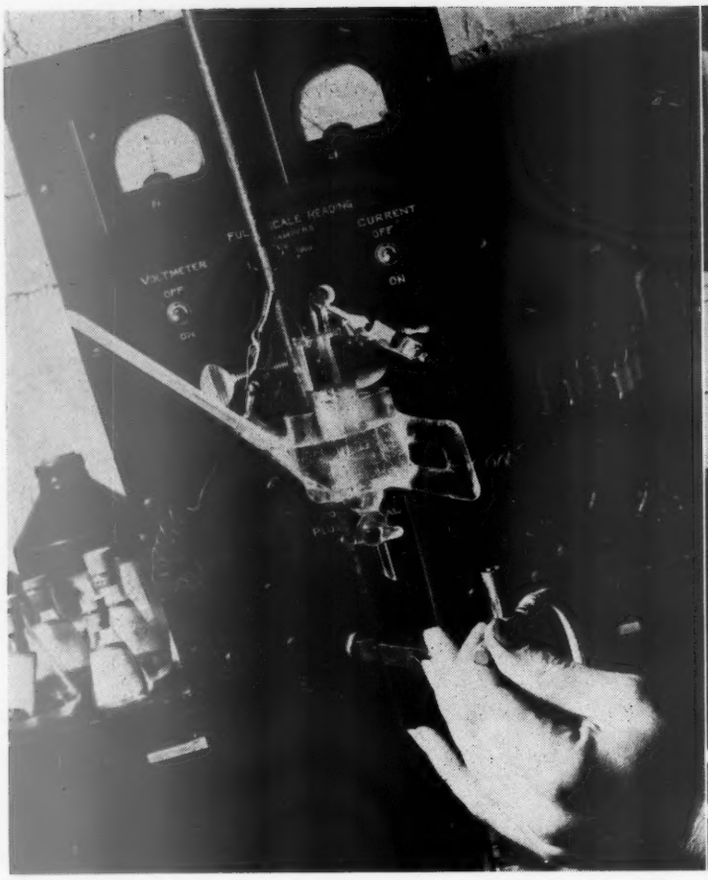


FIG. 2. Weighing the problem. This technique helps the chemist to determine microscopic amounts of metallic contaminants in an oil. To find and weigh this metallic sludge, the petrochemist electroplates the metallic constituents onto a platinum electrode as shown above.

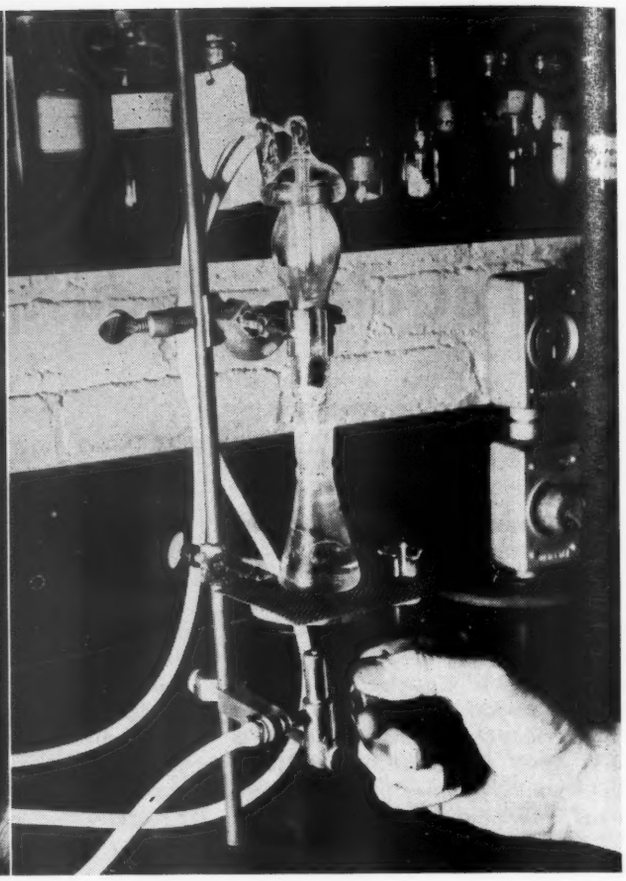


FIG. 3. Mico-extraction. This technique permits the chemists to determine how much of what is to be found in any given piston deposit. After this analysis is made, he can identify the type of dirt or varnish on the piston and determine how much it weighs.

FIG. 4. A new kind of sludge filter. Hand at right is placing a "precipitating reagent"—a chemical that removes the metals from the solution to the bottom where they can be collected—into a sample.

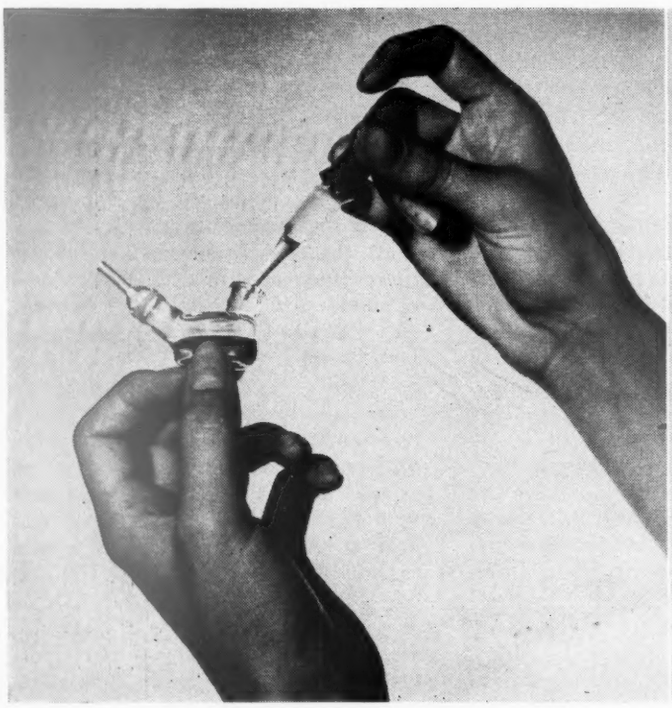


FIG. 5. This Lilliputian beaker holds less than one-fourth teaspoonful—more than enough for the microchemists' needs —and the miniature pipette delivers the necessary minute drop of reagent.

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are of intense interest and importance. The breadth of the petroleum industry's interest in the field of microchemistry is evident from the fact that at this symposium the array of papers even included suggestion for training microchemists and determining hazards.

Although generally the principal reason for employing microchemical methods is that it enables one to obtain information on samples too small for larger scale procedures, there are instances where the microprocedure is so inherently superior that one should employ it even though large quantities of sample are available; an outstanding example in this category is the determination of nitrogen in organic material by micro Dumas procedure. Samples which for one reason or another may be hazardous are best analyzed by microchemical means. The synthesis of nitroglycerin is a common laboratory experiment in microchemistry whereas the conventional larger scale operations would make such an experiment, in the hands of students, unthinkable. Very expensive samples or reagents also lend preference to the methods of microchemistry since the work can be done with so little material that recovery of reagents can hardly be justified.

A fractional distillation apparatus, which is a regular tool of the microchemist, is illustrated in Fig. 1 where the operator's hands, by contrast, show how small the apparatus is. This equipment, in conjunction with auxiliary apparatus for determining boiling point of the minute fractions obtained, has served, amongst other purposes, to determine the nature of anti-freeze materials that have leaked from the cooling system into the crankcase of an engine and there contributed to deposits which were the samples under investigation.

The minute amount of copper that entered a refrigerating oil or the minute amount of silver that left a special bearing and found its way into the lubricating oil, is determinable by the micro - electro - deposition apparatus shown in Fig. 2, where the metal is electroplated on a platinum electrode from which it subsequently can be removed and further identified by microchemical means.

Macro (relatively large scale) chemical methods of examining deposits and sediments are in extensive use. Occasionally the amount of such deposit is exceedingly small — for example those taken from electrical contacts, miniature bearings, etc.— too small for such conventional methods but adequate for microchemical procedures. A microextraction apparatus, shown in Fig. 3, enables the chemist working on a few milligrams of sample to determine and recover constituents such as oil, oxidation products, carbonaceous residues and mineral matter.

Because of the small sample involved, the small quantities of reagents and the special manipulative techniques of microchemistry, certain combinations of analytical operations can be performed in a single vessel, which would be entirely impractical with large samples and the customary apparatus for analyzing them. In Fig. 4 is shown a combination beaker and filter system which enables the microchemist to weigh his sample, dissolve it, precipitate the metal with which he is concerned, filter the precipitate, dry and weigh it—all in the one vessel in which the operation was started. Tilting causes the solution to pass through the fritted glass filter which is an integral part of the left arm of the apparatus, thus eliminating the need for filter paper, separating funnels, etc. Much of the apparatus of microchemistry is conventional laboratory apparatus reduced in size to correspond to reduction in sample size. Thus Fig. 5 illustrates a tiny beaker which is part of the microchemist's facilities. Its size is evident by comparison with the thumbnail of the operator. Although not all the apparatus used by the specialist in this field is minute in size, it is true that the equipment for the bulk of his work could easily fit in a small suitcase. In fact such a collection has been given as a golfer's prize.

Chemical microscopy is, of course, one of the techniques employed by the professional microchemist. Fig. 6 shows him at his specially constructed desk equipped with conventional and binocular microscopes, chemical reagents and auxiliary apparatus. The operation being performed is the electrodeposition of a fraction of a milligram of copper on a tiny electrode fused in a microscope slide. A large portion of the microchemist's work can be performed in this space. The microscopic inspection of minute samples provides the chemist with a great deal of preliminary information which will save him unnecessary complex and time-consuming examinations.

A miniature centrifuge is employed extensively in microchemistry to separate sediments and precipitates impractical to filter. Such a unit, with auxiliary analytical devices, is shown in Fig. 7.

Though the microchemist does much of his work with tiny breakers, centrifuge cones and even capillaries, sometimes the sample is so small that even these apparatuses are too large and he must resort to the use of single wool fibers to absorb sample and perform identifying reactions on the so-

FIG. 6. Microchemist studying electrodeposition of a small fraction of a milligram of copper on tiny platinum electrode.

FIG. 7. Miniature centrifuge is used in microchemistry to separate sediments impractical to filter.

lutions which these fibers retain. Sometimes the sample is not only small but it can not be conveniently isolated mechanically, for example a faint corrosion film on a metal plate or a contaminating occlusion in a metal surface which may not be destroyed. The analysis of such problems employs electrographic transfer, a technique whereby a trace image of the surface is obtained on special reagent papers which are subsequently subjected to spot analysis for identification.

Microchemical methods of analysis have been applied advantageously where the quantities of sample available were inadequate for conventional macro procedures. Among these are samples of watch and instrument oils found on captured war prisoners; legal crime and civil cases; industrial oil and grease problems when examining residues left on bearings after use or storage to determine stability of product and the nature of changes in the metal with which it has been in contact. Other uses in the petroleum laboratory were concerned with examination of residues left from oil or grease on metal in laboratory oxidation tests, for example the Norma-Hoffman Oxidation Test where micromethods enabled one to examine the contents of the individual trays used in this test. Microchemical methods of analysis are also applicable to the products of test tube synthesis research, thus permitting a greater number of preliminary research experiments since only test tube equipment and quantities are required. The application of microchemical methods in quantitative analysis of grease, for example, enables one to determine the properties of the constituents without the necessity of additional time-consuming large scale separations to get portions of sufficient quantity for examination of those constituents by large scale methods. Micropenetration tests can be used in the study of consistency changes that occur in greases on a single bearing in storage or use, a few grams of sample being sufficient as against the pound or so required for the conventional ASTM test.

In addition to the more classical methods of microchemistry the modern petroleum laboratory makes extensive use of the more elaborate analytical systems developed by the physicists and physical chemists. Among these are emission spectrometry, ultraviolet absorption, infrared absorption, polarography, mass spectrometry, x-ray and electron diffraction. These are truly microchemical methods since each of them is capable of yielding very useful special analytical information on as little as a milligram of sample, but because of the elaborate nature of the equipment they can not be discussed further in the space now allotted.

This represents a great step from the analytical requirements put on a petroleum laboratory twenty years ago but as the relatively crude problems, which then seemed of major importance were solved by the better facilities that became available, we may expect the new problems to create a need for still further advances in the science of analysis and determination of properties. These advances are already underway. * * *

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Part 1

Life and Death in an Oil Refinery

P. M. VAN ARSDELL

STATISTICS should mean something when they are accident totals. Unfortunately, it appears that as long as we are not on the receiving end of an accident, we are not sufficiently impressed by them. Our sight, our lungs, our bodies, or our lives may add to these totals in the yearly tally. When we read of accidents in the home, in industry, or on the roads we seldom consider ourselves in the role of victim. Yet there is always the chance that an accident can become a personal problem when it occurs to us, our families, or our friends.

Every year for the past ten years, the record shows that an average of 110 men have met their death in the petroleum industry of our country. The refining division is charged with 35 per cent of this yearly total. But this is only part of the story—lost time injuries in the refinery averaged 2209 per year for this ten year period. How many more fatalities and accidents that remain unreported is anyone's guess.

Petroleum, its processes, and its products may be rated among the most dangerous and unpredictable of the many materials handled in present day manufacture. The statistics show how effort can reduce the toll of accidents and fatalities. During the sixteen years' activity of the Central Committee of the American Petroleum Institute on Accident Prevention the severity rates have been reduced from 2.37 days lost for each 1000 hours worked to 1.35 days; and the fatality rates reduced from one for each 1647 workers to one for each 2922 workers.[8] This is merely an indication of what effort can do. It should provoke serious consideration to adopt greater measures to reduce present day figures of accidents and fatalities that should be considered intolerable.

The circumstances existing within the refinery are conducive to chemical, mechanical, and electrical accidents. High temperatures also account for numerous fatalities and permanent disabilities. Aside from fires and explosions, a serious factor that is ever present, the nature of the raw materials, the processes, and physical equipment includes practically every type of hazard. However, in a careful study of all types of accidents occurring in the nation's refineries, the unfortunate but inevitable fact is clear that the chief hazard of all is man himself. His carelessness, forgetfulness, and unseeing blunders account for many injuries and fatalities every year.

The Author

Prudence M. Van Arsdell was graduated from Indiana University in 1935 with an MA degree in organic chemistry, and a minor in physiology. Prior to the establishment of Benson and Associates, Inc., in 1945, she was associated with Universal Oil Products Company for 10 years, first as assistant to Dr. Gustav Egloff, and later in charge of technical publications for that company.

Since joining Benson and Associates, Inc., she has contributed a number of articles on chemical safety to various journals and is the author of the "Tables on Toxic Chemicals—Symptoms and Effects on the Eyes," published in the "Manual on Toxic Eye Hazards" released by the National Society for the Prevention of Blindness.

Table 1 shows the types of accidents occurring within the refinery. With only a few exceptions, this list is characteristic of practically all accidents from any source. Naturally, the circumstances existing within the refinery enhance the severity of some of the types of accidents.

As will be noted from the reference list, the physiological reactions are taken from the medical reports made public throughout the years and emanate from the industrial physicians, various national and state groups interested in industrial hygiene, and other recognized authorities.

TABLE 1.

Fires and explosions	Striking against objects
Asphyxiation	Strains from lifting
Electrical contacts	Scratches and cuts from burrs, splinters, and sharp edges
Falls on the level	Eye injuries
Falls from elevations	Contact with acid or caustic
Falls into holes	Scalds
Struck by flying objects	Burns from hot objects
Struck by falling objects	Burns from fire
Struck by moving objects	Hand tool injuries
Caught between objects	

How these are distributed as to percentage varies from year to year. It appears from the available records that eye injuries, scratches, cuts, and falls account for the largest number of non-fatal or lost time injuries each year; fires, explosions, falls, electrocution, and asphyxiation were responsible in the order named for the fatal injuries in the refineries.

The subject of fires and explosions will be covered in a subsequent article.

In addition to lost time and fatal accidents there are certain types of occupational disabilities that are not fatal or cause lost time other than a loss of efficiency. There are the various dermatoses, allergies, and other physiological reactions that are peculiar to the handling of petroleum, materials used in various refining processes, or the many products resulting from refining. Unless great care is exercised, these reactions may eventually become severe enough to become compensable injuries as evidenced by the report of Schwartz[133] wherein he states that of a group of 10,000 compensated cases of occupational dermatoses (skin reactions) reported in various states, the principal causes were as follows: (1) Petroleum oils and greases, (2) alkalies, and (3) solvents. Others are listed in this group, but the significant fact is that these three rank highest in the group and that all are basic integral parts of petroleum refining.

Chemical compounds, catalysts, and processes constitute a hazard to the human mechanism. The signs of body reactions have been a source of study for a number of years. Although the more common accidents, such as falls, cuts ,and burns, have taken their toll, it is of vital importance to recognize the nature of the physiological reactions that can result from the many different phases of petroleum processing, and to provide for the alleviation or elimination of such dangers.

EXCLUSIVE

—Courtesy Dr. L. F. Weber.

Dermatitis due to oils — to solvents — to strong alkalies — to solvents

Crude Petroleum and Storage

Crude oils from whatever source are the prime raw material for a refinery and as such present health hazards in handling and storage. These oils contain various types and amounts of gases, salts, and water in solution as they come from the earth. The dissolved gases such as hydrogen sulphide, and lower hydrocarbons—methane to butane—are given off slowly, and the lighter fractions C_5 to C_7 slowly vaporize under storage conditions. The salts remain in solution to cause later difficulties. Each year crude oil is the cause of a number of fatalities and lost time accidents, as gaugers and tank cleaners come into contact with either the gases or the crude.

The volatile gases and vapors emanating from petroleum in storage enter the body through the lungs and are absorbed rapidly into the blood stream. The liquid crude oil on contact with the skin is less toxic, as absorption into the skin and surrounding tissue is much slower. In the order of rapidity of action on the human organism, hydrogen sulphide inhalation ranks first, hydrocarbon gases and vapors second. Liquid material on the skin is far less reactive, but no less irritaing the longer it is allowed to remain in contact with the area.

Hydrogen Sulphide

Of all the gaseous compounds emanating from petroleum, hydrogen sulphide is the most treacherous and deadly. In low concentrations it is easily detectable by the familiar "rotten egg" odor, but in high concentrations, the respiratory center is paralyzed and one lungful can be fatal. From 1938 to 1947, hydrogen sulphide was the cause of four deaths in the refinery area[18].

Low concentrations in the atmosphere initially produce eye and lung irritations as the gas combines with the moisture in these areas forming hydrosulphuric acid with the moisture, and sodium sulphide with the sodium present in the tissues[137]. The eye irritation is very painful with reddening and blisters, and is frequently termed "gas eyes" by the workers. Low concentrations inhaled over long periods produce chronic but not cumulative poisoning, while high concentrations produce either acute poisoning or death.

Chronic poisoning is characterized by the following symptoms that may involve all the moist tissues of the eyes and respiratory tract, and the skin as well, particularly when there is considerable perspiration. The symptoms are nasal, oral, pharyngeal (swallowing), and bronchial inflammation. Severe conjunctivitis with great sensitivity to light, roughening of the cornea, and blistered ulcerated eyelids are characteristic signs of visual area exposure to hydrogen sulphide.[63, 159] Other general symptoms involve the digestive tract; headache, tiredness, and skin eruptions denote a toxic reaction.

The acute poisoning following exposure to high concentrations, if death is not immediate, shows the following—twitching of the muscles, rigidity, and convulsions that are characteristic of asphyxiation, marked slowing of the heart, profuse salivation, and cold perspiration.[137] Should the breathing actually be stopped through paralysis of the respiratory center, the heart may continue to beat for a time. It is during this interval that artificial respiration by the prone pressure method may be effective in saving life if instituted soon enough in the open air.[83, 107] In any event, however, the victim should be hospitalized immediately to provide all possible means of averting pneumonia, which is often an after-effect of inhalation. The following Table 2 shows the effects of the different concentrations of hydrogen sulphide in the air.[107]

Because of the prevalent use within the past several years of high sulphur crudes, West Texas, Venezuelan, and Near Eastern,[48] the danger from hydrogen sulphide poisoning both acute and chronic is well recognized. Even when sour crudes are mixed in the storage tanks with sweet crudes, vigilance cannot be relaxed. All men required to work in the presence of hydrogen sulphide fumes should be compelled to wear fresh air masks or approved type canister gas masks properly adjusted. Tank car loading and unloading, tank gauging, and tank cleaning are the main operations where adequate precautions are necessary against the presence of hydrogen sulphide emanating from the crude.

The following safety measures

TABLE 2.

Concentration of Hydrogen Sulphide			
Mg/Liter	PPM	Per Cent in Air	Effects
0.14-0.21	100-200	0.01-0.015	Symptoms of local irritation after many hours exposure.
0.28-0.42	200-300	0.02-0.03	Causes local irritation if inhaled for 1 hr, and slight general symptoms if inhaled longer.
0.70-0.97	500-700	0.05-0.07	Causes local irritation and slight systemic symptoms within 1 hr. May cause death after exposure of several hours.
1.0	900	0.09	Causes systemic symptoms in less than 30 min. May cause death in 1 hr.
1.7	1500	0.15	Causes death after 15–30 min.
2.0	over 1800	0.18 & over	Causes almost immediate death through paralysis of breathing center.

should be the rule for all men engaged in this work.[153]

1. The men should work in pairs.
2. Proper masks and goggles should be used.
3. All work should be done from the windward side.
4. Allow certified personnel only in the area.
5. Leaks must be reported at once.
6. Do not continue to work in an area where hydrogen sulphide fumes are noticeable.
7. In tank cleaning operations life lines should be attached to safety belts.
8. Also in this operation, air supplied masks only, should be used, with air supply coming from an uncontaminated area. A second man should be outside the tank to summon help if necessary.

In addition to the above precautions, an adequate cool water supply should be near enough to permit eye washing of at least five minutes in case of eye irritation. A training program in first aid measures for all personnel working near the area should prove of value in saving lives from hydrogen sulphide exposures; often the prone pressure method of artificial respiration can institute breathing before the heart action stops if begun soon enough after massive exposures.

As a general rule it might aid also in general hygiene if the workers are required to take frequent medical examinations so that proper measures can be taken to prevent chronic poisoning.

Hydrocarbon Gases and Vapors

Hydrocarbon gases and vapors and crude oil fumes present a less deadly but markedly dangerous hazard in the storage area. Inhalation is the chief means of the vapors entering the body. Although the skin is quite sensitive to crude oil contact, the liquid does not rank with the vapor as a source of physiological reaction. The volatility of the oil as well as the type of oil, that is, paraffinic, naphthenic, or aromatic[96, 101], is an index of the general toxic effect, the aromatic being the most deadly; benzene and its lower homologs are the most dangerous of the hydrocarbons not only from inhalation but also skin contact.

The vapors from crude oil range from C_3 to C_7 and their action is generally one of anesthesia.[58] The central nervous system is affected, and the immediate symptoms of poisoning vary, with dizziness, nausea, vomiting, and sleepiness predominating. The conjunctiva is congested, and there may be a feeling of burning in the chest.

Because of the anesthetic action of the lighter vapors (C_3-C_5) distinct warning symptoms are not produced after several minutes of exposure to the hazardous materials in air mixtures.[76, 83, 119, 146] The inhalation of a quantity of vapor over a prolonged period leads to various symptoms of acute poisoning. Sometimes a state of excitement resembling drunkenness is present. The workmen may be confused and refuse to leave the area. Fatigue, sleepiness, and a feeling of tightness in the head with ringing in the ears, and dizziness are all symptoms of poisoning from crude oil vapor. In severe acute cases, the lethargy may last for several days; loss of consciousness with a retrograde amnesia and great excitement have all been observed.[58]

The excitement may take the form of acute mania and sometimes delirium and hallucinations. The body reactions are tremors,[83] tendon jerks,

Artificial Respiration.

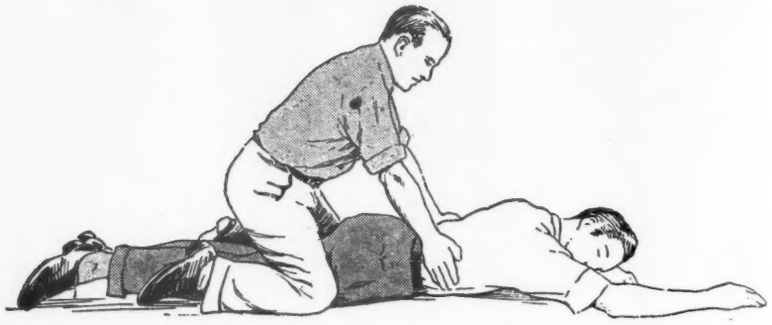

FIG. 1. Starting position for artificial respiration, resuscitation of accident victim. Note position of patient's arms and head, and of operator's hands.

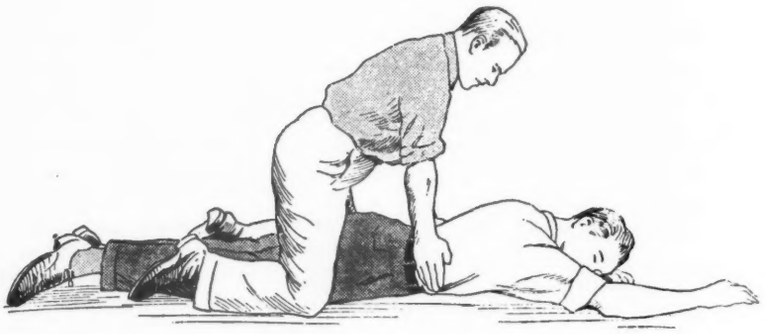

FIG. 2. Compression is applied to the lower part of the chest in this second position of the artificial respiration cycle.

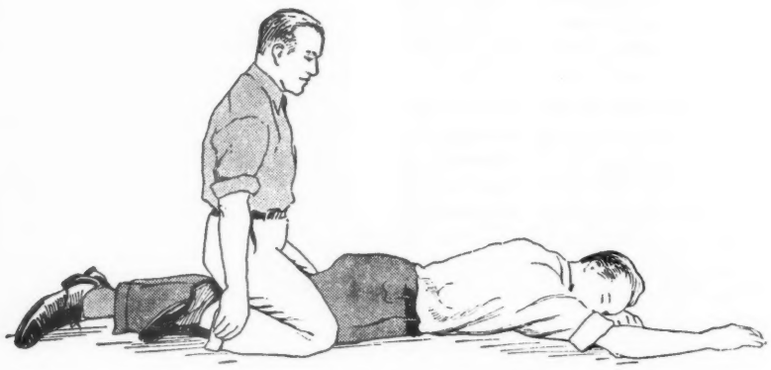

FIG. 3. Third step in artificial respiration, which allows the patient's lungs to inflate. The cycle is repeated until the patient is breathing naturally or until it becomes absolutely certain that breathing cannot be started.

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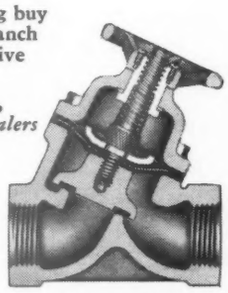
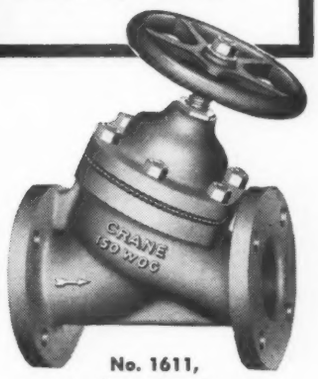


No. 1610, screwed ends

No. 1615, flanged ends, neoprene coated



No. 1611, flanged ends

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and convulsions. Numbness, speech disorders, difficulty in swallowing and respiration may all be present. The victim may complain of feeling cold, and an actual fall of body temperature may be observed, with diminished respiratory and pulse rate. The hands and feet may turn blue showing some circulatory disturbances.

Chronic poisoning is characterized by anemia, dizziness, nasal irritation, conjunctivitis, dilation of the pupil, an oscillatory movement of the eyeballs (nystagmus), or paralysis of the eye muscles.[94] Bronchitis, violent attacks of suffocation, sometimes accompanied by inflammation and pneumonia may follow either acute or chronic poisoning. Cancer of the lungs has been reported following the continued inhalation of crude oil vapors.[58] Generally the effects are not cumulative; however, if the aromatic compounds are present as in California or Borneo crudes, cumulative poisoning may result.

Workers engaged in tank cleaning have more reason to encounter crude oil vapors than any other general group although the gaugers, too, have some exposure. Before entering the tanks for cleaning, proper precautionary measures must be taken. The area should be gas free and the men properly outfitted with respiratory equipment, preferably air supplied hose masks. A hazardous atmosphere may be formed when bottom sludge is stirred during cleaning operations; iron sulphide on oxidation may give rise to explosions. Harmful concentrations of vapor may also enter a tank if lines or connections from adjoining tanks are not blocked off.[40] In addition to the toxic hazards, the dangers of explosion and fire are ever present.

A safe method of washing tank bottoms by means of water pressure has been developed and operated. The bottoms are washed away by external operation without opening the tanks. A two-inch water line encircles the outside circumference of the tank near the base and feeds a series of Veejet nozzle water jets that are installed as near the bottom of the tank as possible. The jets are designed and adjusted to exert sufficient water pressure in the direction desired to wash the tank bottom thoroughly. The sediment and sludge are washed out finally through a 6-in. outlet drain. An alternate type drain can be installed in locations where water is scarce, as the same water can be used over again. A 2000 bbl tank has been cleaned successfully in 1 hr and 20 min by the regular personnel using outside operation.[40]

Prevention of exposure to vapors should be the aim of all persons in charge of safety, yet too frequently accidents involving such exposures do occur. An educational and training program for all persons in and near these areas should be instituted to care for exposures, especially where a man may be unconscious or not breathing. When loss of consciousness has occurred the victim should be placed on his back and covered after removal to fresh air.[23] Should breathing have stopped, prone pressure artificial respiration must be started at once. Medical aid should always be summoned immediately as soon as any type of exposure is suspected. Even if the person seems all right upon recovery in fresh air, he should be sent for a medical check-up to avert any untoward reactions such as bronchitis or pneumonia developing.

The problem of skin contact is not so noticeable as an inhalation reaction, but unless proper precautions are taken it can be very annoying for a long period. Too often a splash of crude oil is wiped from the area with a greasy, dirty waste that takes away only the sensible or visible quantity of oil, leaving a film on the skin frequently combined with considerable dirt or particles of metal. Irritation from crude oil stimulates the outer layers of the skin to growth, and in time certain individuals may have growths of either malignant or benign tumors.[127] The heavier oils seem to be more damaging to the skin,[81] certain types of oils particularly those containing high percentages of heavy paraffins causing more damage. With these a tendancy to chronic lesions, high incidence of warts, boils, and ulcers is seen as well as frequent skin cancer.[58] These lesions seem to occur as a result of closure of the pores of the skin sealing in all the injurious micro-organisms, which inflame the hair follicles and cause pus formation. Closure of the sweat glands causes thickening and reddening of the skin.

Prevention of most skin reactions can be the rule, if proper hygienic measures are instituted. Whenever there has been a skin contact with crude oil, there may be redness and some itching denoting the affected area. Thorough washing with soap and warm water at frequent intervals is usually sufficient to remove the irritant. Should excessive dryness be noticed, lanolin ointment is soothing and healing for most skin reactions. However, should the inflammation persist and become acute, a physician should be consulted at once. Neoprene gloves should be worn to protect the hands from crude oil contact, and if splashing is prevalent rubber aprons as well.

Tank Repairing

While tank cleaners and gaugers are the two groups regularly concerned with crude oil storage, repairmen are required occasionally for tank maintenance. Although they seldom contact the oil or its vapors, the welding operations necessary to repair the leaks sometimes create gas hazards unlike those in the ordinary group just discussed. In enclosed areas, the concentration of carbon monoxide from acetylene cutting operations, nitric oxides, or metal fumes frequently build up to concentrations detrimental to health.[45, 108, 135]

Generally it is the rule that all men engaged in this type of work wear adequate respirators; failure of the protective equipment through leaks or improper adjustment of the equipment by the wearers can lead to poisoning, the indications of which are shown for carbon monoxide, nitric oxide, and metallic fumes.

Carbon monoxide inhalation causes the following symptoms: tightness across the forehead, painfulness of the eyeball, dilation of the blood vessels of the skin causing the characteristic red patches to appear on the front of the body. Frontal and basal headache, throbbing in the temples, tiredness, weakness, dizziness, and nausea indicate asphyxiation. Vomiting, loss of strength, and muscular incoordination somewhat similar to hydrocarbon gas poisoning are also observed with increased pulse and respiration rates, followed by collapse. Anemia, or a marked increase in red corpuscles, and the presence of carbon-monoxide hemoglobin indicate the blood reaction.[65, 107] All of these signs are characteristic of oxygen starvation of the tissues.[66] Usually the larger the person the longer the time necessary before symptoms appear. In some persons no symptoms are noted prior to collapse. When high concentrations are present for short periods, degenerative changes in brain and eye tissues may manifest as amnesia and partial or total blindness. Recovery may be rapid or delayed. There are no indications such as irritation of the respiratory tract, nor does carbon monoxide have any odor.[107]

The first aid procedure consists of removal of the individual from the poisonous atmosphere immediately (the rescuers should be equipped with masks) and if in a state of collapse, artificial respiration should be instituted promptly. The patient should be hospitalized as soon as possible so that measures can be taken to eliminate the carbon monoxide from the blood stream.[107]

Nitrogen oxide fumes are often

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generated from atmospheric nitrogen by heat from either the oxyacetylene or electric welding procedures. The symptoms of such inhalations are cough and nausea initially, which may subside entirely, or after a period of quiet reappear as a more serious cough accompanied by difficulty in breathing. Weakness and nausea follow the later onset and in some instances there may be considerable edema in the lungs that causes even more difficult breathing and may be the forerunner of death. Although there may be no latent period, the mildness of the symptoms is no sign that the final outcome may not be serious. When a high concentration of nitrogen monoxide is present, the central nervous system is depressed; nitrogen dioxide in excess causes more local irritation and leads to lung edema. Upon recovery, however, there seem to have been no after effects reported in the literature.[99]

Continued exposures to low concentrations of these fumes are said to cause chronic inflammation of the respiratory tract and general disability characterized by headache, sleeplessness, loss of appetite, gradual loss of strength, dyspepsia, constipation, and ulcers on the lips and mucous membranes of the mouth.[65]

First aid consists of removing the individual experiencing untoward symptoms to fresh air immediately, and hospitalizing at once, so that the pulmonary edema likely to ensue can be given adequate treatment. Complete rest is also recommended after such exposures. Prevention lies in proper use of protective equipment, thoroughly tested for leaks, an air supplied respirator being the best protection.[99]

Reaction to inhalation of metallic fumes or oxides such as brass, cadmium, lead, tin, copper, nickel, zinc, or iron—any metal of which storage tanks are alloyed, painted, or lined is characterized initially by slight irritation and dryness of the throat. When the worker has been in the open air for some hours after the exposure, the main symptoms of poisoning appear, which are aggravated by cooling the body. These resemble a malarial chill with fever, exhaustion, headache, nausea, muscle cramps, and joint pains, with a feeling of tightness in the chest all appearing. The attack ends within 12 to 24 hours with perspiration and rapid return to normal.[137] When such metals as mercury, manganese, lead cadmium, or antimony are present more dangerous chronic poisoning is apt to occur, and continued exposure to such fumes is extremely dangerous.[65] Adequate ventilation and proper respiratory equipment is mandatory whenever welding repairs are to be made.

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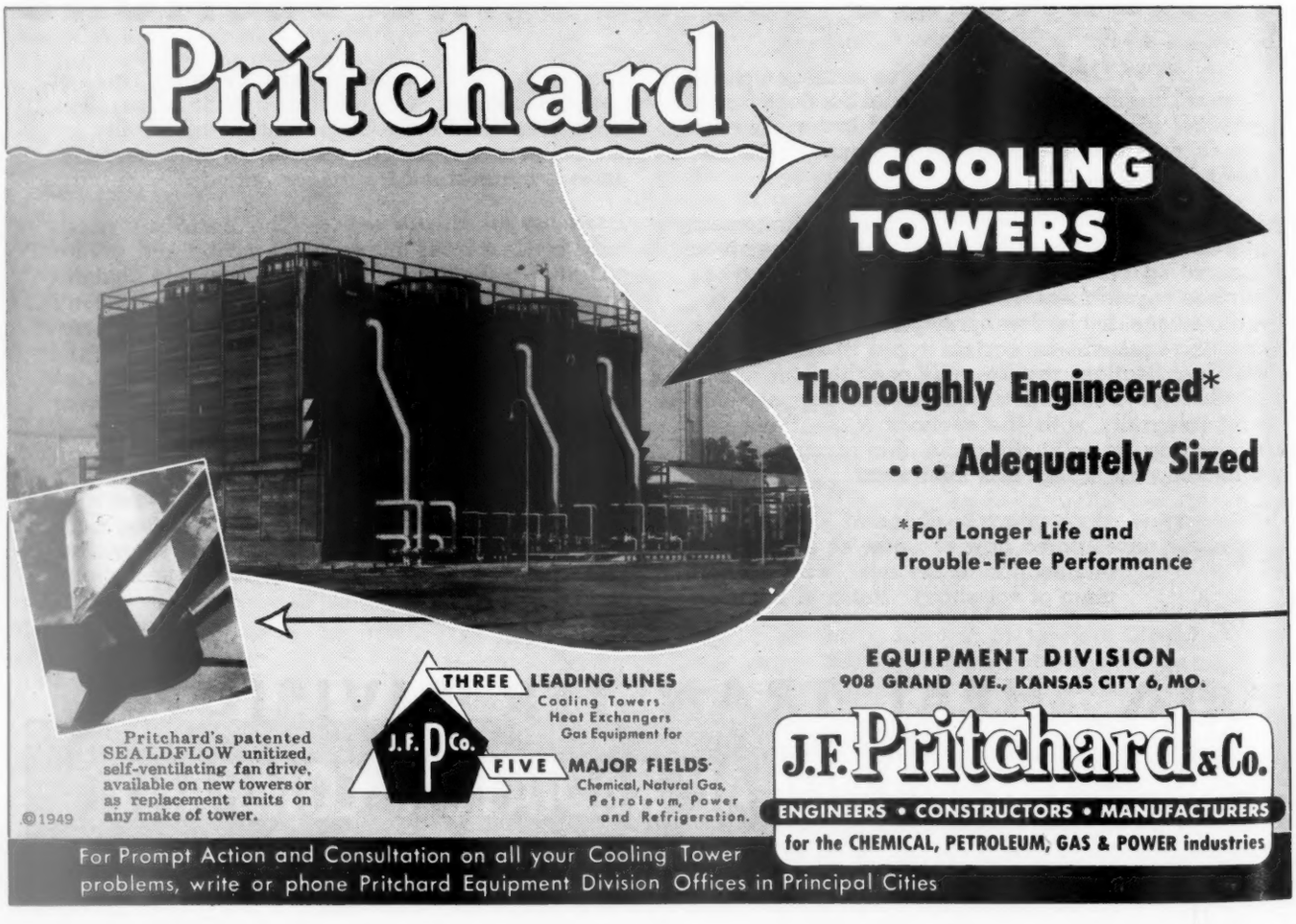
Part 2 will be published soon.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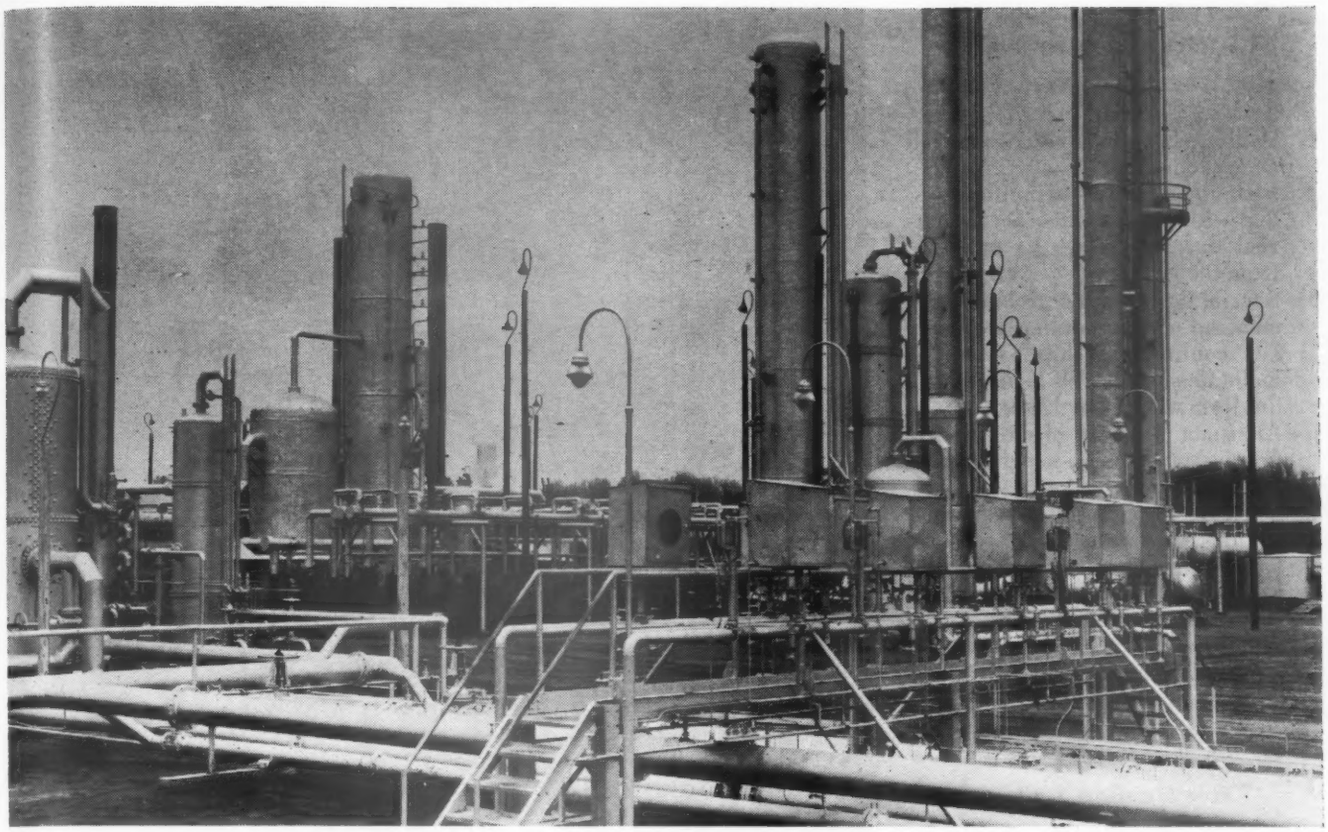


FIG. 10. Meter manifold and process equipment.

High LPG Recovery at New California Plant

M. E. GARRISON*

PART 3—CONCLUSION

Part 2 of this article discussed details of LPG recovery; an efficient propane refrigeration unit is included in the plant process layout. Thirteen meters are employed to measure the gas at various pressures and in different lines for the many purposes for which it is required. Absorption oil is reconditioned by vaporizing and condensing under 10-in. of mercury vacuum. Five compressors are used in the system; jacket water is maintained at about 120 F.; hot water in the compressor jackets makes for longer ring life and less cylinder wear.

Induced Draft-Cooling

Preliminary weather investigation revealed periods as high as 30 days with very little wind available and at the same time wet bulb temperatures as high as 72 F. Also there was found that ground fogs due to irrigation at certain times of the year, caused high wet bulb temperatures and high humidity conditions. These data led to the consideration of the installation of an induced draft cooling tower.

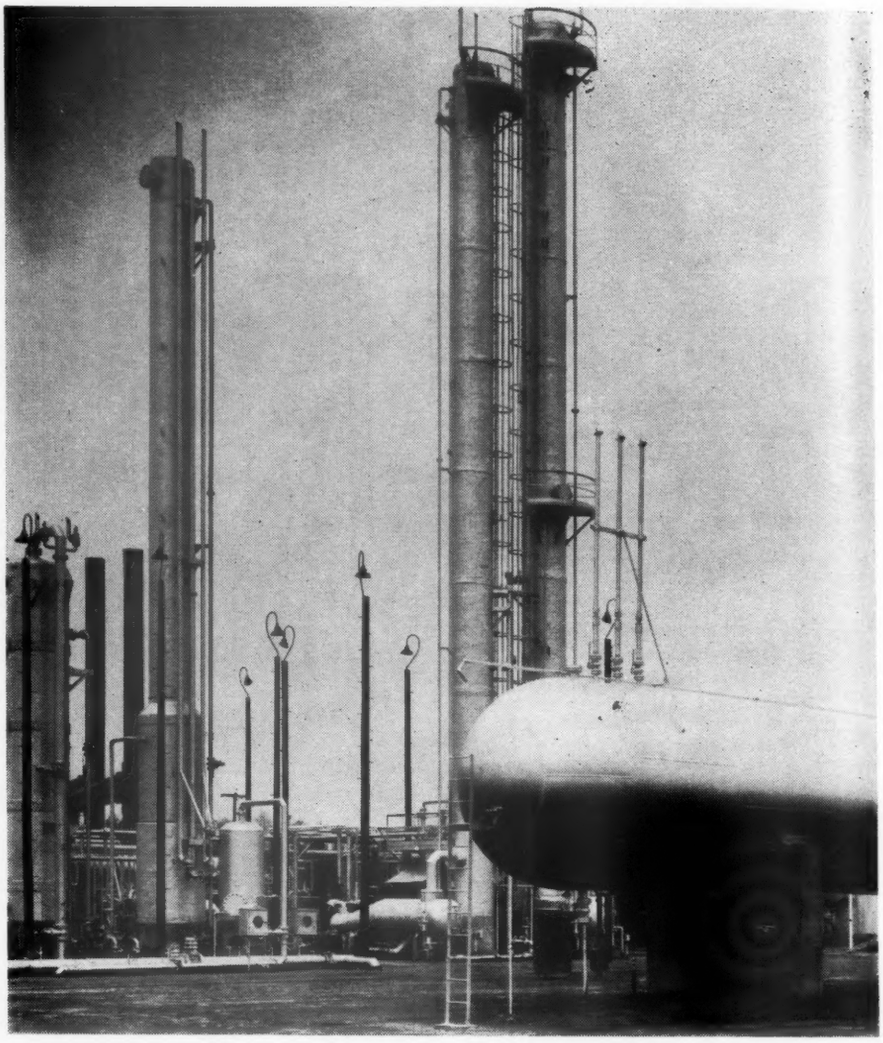
A study of various induced draft manufacturers' designs led to the installation of a 24 bay, 6 cell, 24 ft wide by 144 ft long by 40 ft high cooling tower. On the top of each cell of 4-6 ft bays was installed a 12 ft diameter induced draft fan assembly consisting of 6 stainless steel fan blades mounted horizontally on top of a gear box driven by a gas engine. Atmospheric cooling sections 20 ft long were arranged so that they could be stacked four high in the base of the cooling tower. The guaranteed rating of the cooling tower stated that the cooling tower would cool 7200 gal of water per minute from 100 F to 80 F with a 72 F wet bulb temperature. This represented 0.4 of an inch of water draft in the entrance of the fan duct which equals a fan velocity of approximately 302 fpm.

Design features in this tower include the following:

a. Six stainless steel fan blades installed in each cell.
b. Fans are driven by gas engine through a 5-to-1 gear.
c. Draft eliminators to prevent water from being carried from the tower.
d. Removable cooling water decks of sufficient strength to permit removal for cleaning and hosing off.
e. Vapor stack with damper, installed vertically from the atmospheric cooling section through the draft eliminators to permit the removal of hot water vapor.

*Project Engineer, General Petroleum Corporation.

FIG. 11. Propane storage and LPG fractionating equipment.



f. Double outside ventilated wall construction.
g. Pick-up and redistribution system with water control levers carried down so as to be operable from the ground.
h. Special hot water control arrangement on certain cooling sections; i.e., cooling gas that has to be maintained above 60 F to prevent the formation of hydrates.
j. Alternate spacing of coils with passageway between to permit easy access for cleaning.
k. Stacking of atmospheric cooling sections with cold services above hot services so as to economically permit the flow of sufficient water over the coils to reduce scaling tendencies.

In Table 5 is shown an approximate distribution layout for the water and for the heat loads in the induced draft cooling tower.

Fractionating Unit

In general the fractionating unit was designed to produce stabilized 18 to 26 lb vapor pressure gasoline, liquid propane, and a mixture of butanes for further mixture with propane to make an LPG sales product. A simplified flow sheet is shown by Fig. 9. It is the conventional flow in which the raw gasoline is depropanized in the first column with the bottoms from this column feeding the debutanizer column. In the debutanizer column the stabilized gasoline is drawn from the bottom of the column and LPG product is taken overhead. The vent gas from the depropanizer reflux accumulator may be taken to field fuel or to the 150 psig absorber as desired. Any vapor from the debutanizer reflux accumulator is taken to the recycle scrubber and reprocessed.

The bottom temperatures of these columns are controlled by the temperature of some plate in the column below the feed plate, or several plates up from the bottom of the column as determined experimentally in the field.

The depropanizer column has ten more fractionating plates installed than are normally required for this type of column. The purpose of these plates is to permit the withdrawal of propane having approximately 99 per cent purity at from six to ten plates below the top plate. By using a

FIG. 12. Compression and auxiliary equipment building.

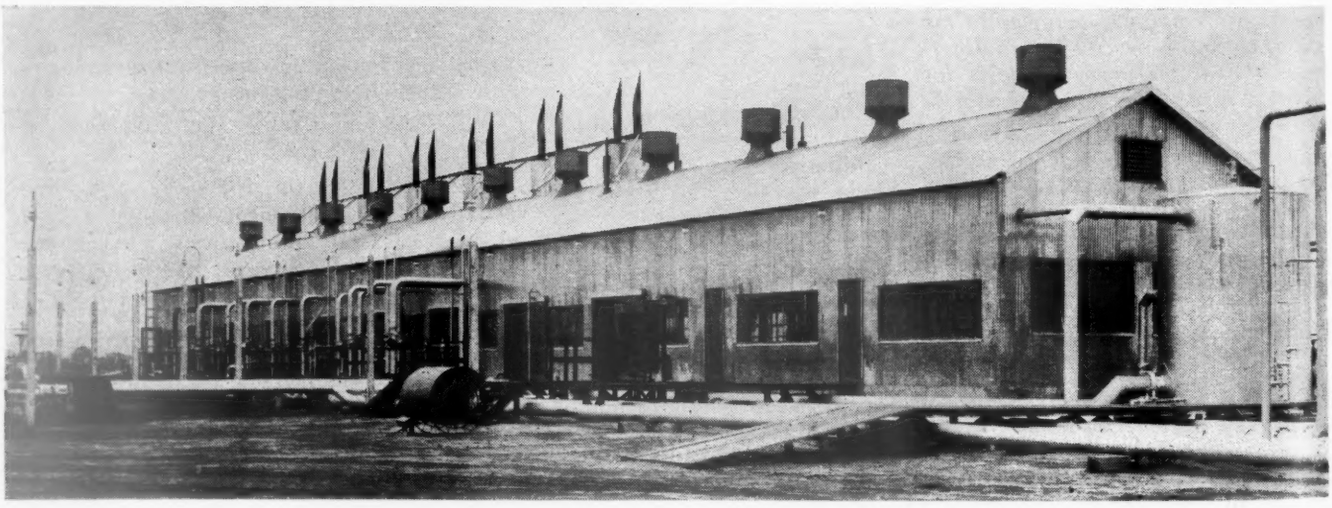


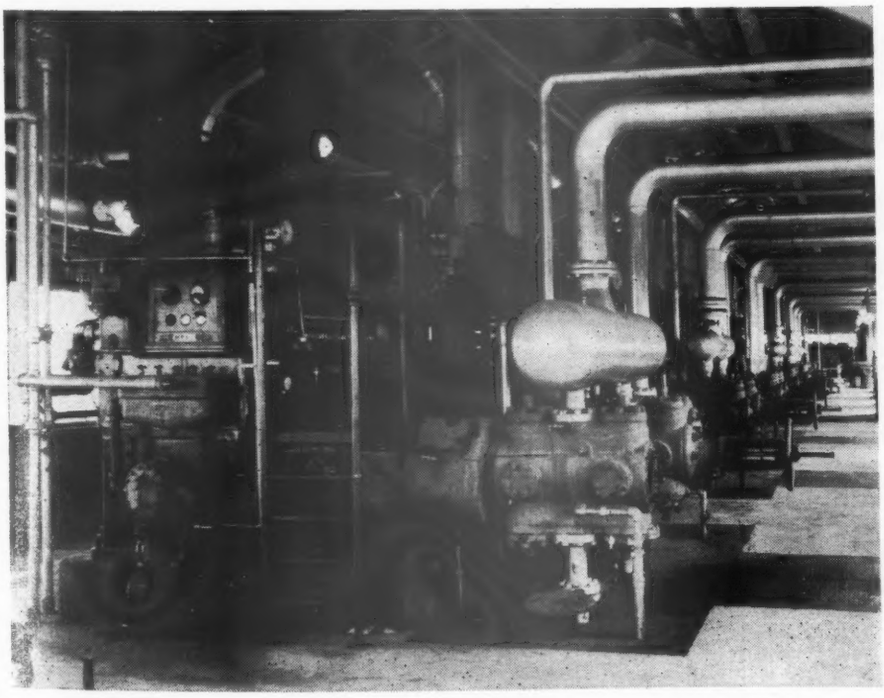
TABLE 5. Induced draft cooling tower arrangement and heat data.

CELL NUMBER	1				2				3				4				5				6			
BAY Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Water Cooled per Bay	1200 gpm				1200 gpm				1200 gpm				1200 gpm				1200 gpm				1200 gpm			
Maximum	1350				1350				1350				1350				1350				1350			
Required over Coils	1950				0–1300				1230				1220				500–1000				1400 gpm			
Water Flow Across Deck	750 gpm				←		←		450 gpm				← 480		← 500 (0)		→				→ 200 gpm			
									450 gpm															
Excess	900 gpm																							
BAY RATING																								
M Btu's	5.25		6.10	7.80					3.40	1.50		5.00	4.00		4.00	2.15			6.00		6.00	6.00		3.00
Gpm	600		600	750		600	700		450	350		500	460		460	300		500	500		500	500		400
Temp. Rise F	17.5		20.5	21.0					15	11		20	17.5		17.5	14.5								
Tubes number	42		42	54		42	50		34	26		38	32		32	21		36	36		36	36		28
Size	1 in.		1 in.	1 in.		1 in.	1 in.		5/8 in.	5/8 in.		1 in.	1 in.		1 in.	1 in.		1 in.	1 in.		1 in.	1 in.		1 in.
Gpm per tube	41.3		14.3	13.9		14.3	14.0		13.2	13.5		13.2	14.3		14.3	14.3		13.9	13.9		13.9	13.9		14.3
Box style	Open		Open	Open		Open	Open		Closd	Closd		Closd	Open		Open	Open		Open	Open		Open	Open		Open
COIL RATING																								
ARRANGEMENT	C-1		C-6	C-10	Vac-	Spr.	Spr.	Vac-	C-2	C-3	Vac-	C-7	C-4	Vac-	C-4	C-4a	Vac-	Spr.	C-13		C-13	C-13	Vac-	C-5
			C-6	C-10	ant			ant	↑	↑	ant	↑	↑	ant	↑	↑	ant		C-13		C-13	C-13	ant	C-5
	C-12		C-12	C-12					C-2	C-3		C-7	C-4		C-4	C-4a			C-5 →		C-5	C-5	→	C-5
	C-12		C-12	C-12					C-2	C-11		C-7	C-4		C-4	C-4a			C-5 →		C-5	C-5	→	C-5
Gpm Design Temp Rise °F.	360 7°		600 7°	750 10°					300 23°	280 7°		500 20°	320 19°		320 19°	210 19°			400 10°		400 10°	400 10°		400 15°
Gpm Design Temp Rise °F.	600 13°		600 13°	600 13°						280 3½°						300 1°			400 20°		400 20°	400 20°		400

Note: Coil Designation—

C-1 150 psig Wet Gas–A
C-2 450 psig Wet Gas–B
C-3 600 psig Dry Gas–C
C-4 Lean Oil Coolers
C-5 Gasoline Condensers
C-6 Recycle Gas–D
C-7 Depropanizer Condensers
C-8 Propane Cooler
C-10 Debutanizer Condenser
C-11 Stabilized Gasoline Cooler
C-12 Jacket Water Coolers-Engine Jacket
C-13 Propane Condensers, Refrigeration Cycle

FIG. 13. Interior of compressor building.



large reflux accumulator and over refluxing the column maximum withdrawal of the propane content can be accomplished. Connections have also been installed so that a stripper operation could be installed at some later date for a continuous removal of the maximum per cent of the propane content having a 98-99 per cent purity.

The fractionating plates installed in this depropanizer column are specially designed by the writer and the C. F. Braun Company engineers. A balanced vapor and liquid design has been used which permits a higher maximum capacity than usually found in 48-in. diam columns. This design permits a considerably larger number of bubble caps to be installed than are usually found in conventional designs.

The stabilized gasoline from the debutanizer column is piped from the column through a reboiler, feed heat exchanger, atmospheric cooler in the induced draft cooling tower, and to the storage tanks. The heat exchanger delivers heat to the raw feed gasoline on its way to the depropanizer column.

Horizontal duplex pumps used for

feed and for reflux, are rate-controlled. A throttle valve placed in the discharge line from the pump provides the necessary pressure drop, which varies with the rate, for controlling the steam to the duplex pumps. This practice is found to avoid pulsation troubles that are found to give trouble with the conventional rate control method.

Exhaust Steam

Exhaust steam from the horizontal duplex steam pumps was balanced against the heat requirements for the depropanizer reboiler, debutanizer reboiler, feed water heater, and for still agitation purposes. It was found to be desirable, for control purposes, to provide a lesser amount of exhaust steam than that actually required so that a small quantity of live steam would be needed to balance the requirements. This reduces the exhaust steam going to the air to a minimum when considering pumps that are operated intermittently, such as shipping pumps. In order to accomplish this balance the remainder of the pumping load was gas engine driven. The depropanizer reboiler had to be designed with ample surface in order to obtain the maximum temperature with the lowest exhaust steam pressure without undue cost.

All horizontal duplex steam pumps in the distillation unit area and in the storage tank and shipping area are connected to a common exhaust steam header which is operated at from 40 to 60 psig. The excess exhaust steam from this header flows through a back pressure regulating valve installed in a line to the feedwater heater which is located at the boiler plant. The line to the feedwater heater is operated at from 2 to 5 psig which is controlled by a back pressure regulating valve installed in a stack-to-air line. The exhaust steam from the shipping pump areas can also be tied alternately into the 2 to 5 psig line to the feedwater heater as desired. A reducing regulator controls the amount of live steam make-up to the 40-60 psig exhaust steam header. The 40-60 psig line is connected into the still through a rate control and into the depropanizer and debutanizer reboilers through temperature controlled steam regulating valves. The horizontal duplex boiler feed pump exhaust steam is connected into the 2 to 5 psig exhaust steam header to the feedwater heater.

Steam Condensate

Steam condensate is piped from the reboilers, and from steam traps to a hot condensate flash or surge tank which is located at the classifying sump. Any accumulated lubricating oil is skimmed off the surge tank into the classifying sump. The hot water condensate is pumped to the boiler feed tank.

Cold condensate water from the gasoline dewatering pots and the run-down accumulator installed at the still is taken to a separate compartment in the classifying sump where any contained gasoline may be removed. From this compartment in the classifying sump the cold condensate is pumped to the boiler feed tank. **

Contractors

The Bechtel-McCone Corporation made the necessary drawings and constructed the gasoline plant under the direction of the engineers for the General Petroleum Corporation.

The Pacific Pipe Line Construction Company, installed the field gathering system, including the gas booster compressor stations.

M. E. Garrison was project engineer for General Petroleum Corporation.

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NEWS

Gasoline Plant Dedicated

Dedication ceremonies for the Slaughter gasoline plant near Sundown, Texas, were held at the plant site recently. (See Page A-35.)

William J. Murray, Jr., Olin Culberson and Ernest O. Thompson, members of the Texas Railroad Commission, attended the ceremonies, and Murray, the commission chairman, was the principal speaker. Also present at the ceremonies were employes and executives of oil companies operating in the Slaughter field, and civic leaders.

The plant will extract butane, propane and natural gasoline from casinghead gas produced in the Slaughter field, and is one of a number being built to conserve the state's natural resources.

Celebrates 25th Anniversary

The research and development department of The Atlantic Refining Company held open house all day May 21 at the research center in the Point Breeze refinery, Philadelphia, Pennsylvania, to celebrate the 25th anniversary of its organization. More than 2500 visitors, including employes and officials of the company and their families, attended the ceremony.

Hundreds of exhibits were in operation for the inspection of the guests. These were arranged to show the various steps in modern petroleum research, from the first stages of experimentation to the development of the final products.

Refineries Moved

The major part of the Caminol refinery at Santa Fe Springs, California, is being dismantled by W. M. Barnes Company and shipped to Belgium, it has been announced. This constitutes a large part of the $2,000,000 construction program of Raffinerie Belge De Petroles S. A., at the Antwerp refinery. Equipment from California includes two cracking units, a naphtha reforming unit, treating unit, gas recovery unit, complete steam generating unit and other auxiliary equipment. Complete drawings have been made to guide the staff in re-erecting the plant, for reconditioning and for modifying some of the units. The Belgian company also plans to add a new topping unit to the Antwerp refinery.

This is the third refinery to be transferred to distant destinations in the recent past. The Barnes Company has handled the dismantling and rebuilding of the wartime Canol plant, from Whitehorse to Edmonton, Alberta. The Pathfinder refinery was transfered from Los Alamitos, California, to Naples, Italy, for the Socony-Vacuum Oil Company.

Standard of California grease plant at Richmond, California, refinery.

Petroleum Products Plant

Standard Oil Company of California's new package and grease plant is now in operation at the Richmond, California, refinery. The 7½-acre unit is virtually a push-button factory for the manufacture of more than 250 miscellaneous petroleum products and for the storage and shipment of nearly every product the company puts in packages and which range from pharmaceutical white oils to the heaviest types of greases. Loads handled vary from small cases of sewing machine oil to pallets of drums weighing more than a ton.

The basement floor has one mile of roller conveyors, along which the heavy drums are "switched" at a rate of one every three seconds, by electronic controls to railroad spur tracks, to truck loading docks and to storage. Stocks are moved through 20 miles of pipe lines which lace the building. Greases, lubricants and specialties, production of which is at the rate of 38,000,000 lb a year, are mixed in 29 giant-sized versions of the automatic kitchen mixers, with capacities of from 10 to 75 bbl per batch.

The huge building, which will stock 160,000 packages, ranging from 4-oz cans to 415-lb bbl is lighted with 1200 incandescent, 500 flourescent lights.

Refinery Expansion Planned

Plans for a $10,000,000 expansion of the Salt Lake Refining Company of Salt Lake City, Utah, have been announced. Catalytic cracking facilities of latest design, embodying all applicable improvements developed since the end of the war, additional storage facilities for both finished and unfinished products, loading racks, feeder lines, and other auxiliaries, are planned for this Standard Oil Company of California subsidiary.

New cracking facilities are expected to be completed by the end of 1950 with actual construction starting several months from now. Installation of new tankage will begin soon, probably within the next several weeks.

Refinery will continue to handle crude oil from the Rangely field. There are indications some of Utah's own crude oil eventually will find its way to the Salt Lake refinery when commercial production warrants.

Cost of Bottle Gas Cut

The success of a new process for removing propane from natural gasoline may make for cheaper "bottle gas" for consumers. Propane is the chief component of bottle gas.

Speaking before the American Institute of Chemical Engineers meeting in Tulsa, Oklahoma, Ben M. Holt, Ralph M. Parsons Company, stated that the new process, hypersorption, was more economical, when compared on a common basis, than the conventional oil absorption method of extracting propane.

Refinery to Be Enlarged

A modernization program which will completely revamp Deep Rock Oil Corporation's Cushing, Oklahoma, refinery has been inaugurated.

The 5000-bbl fluid catalytic cracking plant will be converted into a new and more up-to-date construction, with work to begin immediately, W. H. Garbade, president, stated.

In store for the new refinery, are a new crude battery, feed-preparation unit, heavy-oil vis-breaker, gas-recovery plant, and enlarged polymerization plant, together with such equipment as enlarged boiler house, cooling towers, and water supply. A new research and development laboratory and a modern refinery office building also are to be built immediately.

Association to Meet

The Commercial Chemical Development Association will have an open meeting, to which all interested in its activities are invited, at the Niagara Hotel, Niagara Falls, New York, June 24, 1949, under the chairmanship of George F. Rugar, assistant manager, technical service division, Diamond Alkali Company, Painesville, Ohio.

Papers will be given by W. J. Riley, manager, technical sales division, Westvaco Chemical Division, and J. S. Reichert, manager, Peroxide Products Development, electrochemical department, E. I. du Pont de Nemours and Company.

Afternoon and evening speakers include R. B. McMullin, of R. B. McMullin Associates; R. A. Lindsey, heavy chemical sales division, Dow Chemical Company; J. M. Gillett, director of industrial research, Victor Chemical Works; and E. C. Crocker, of Arthur D. Little, Inc.

Gasoline Plant Enlarged

Continental Oil Company has announced that it will spend approximately $1,500,000 for the enlargement of the company's natural gasoline plant in the southern tip of Texas. Located in Starr County, 45 miles northwest of McAllen and 20 miles northeast of Rio Grande City, construction is to begin immediately on the expansion project. Gas processing facilities will be increased from a capacity of 13,000,000 to 20,000,000 cu ft of gas daily.

The enlarged plant will have a daily average production of approximately 5800 gal of butane and approximately 25,000 gal of gasoline and will return approximately eight and one-half million cu ft of gas to the five main reservoirs daily. Other gas available will be sold to a pipeline outlet.

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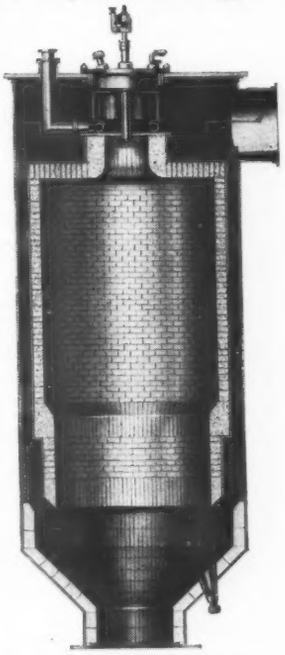

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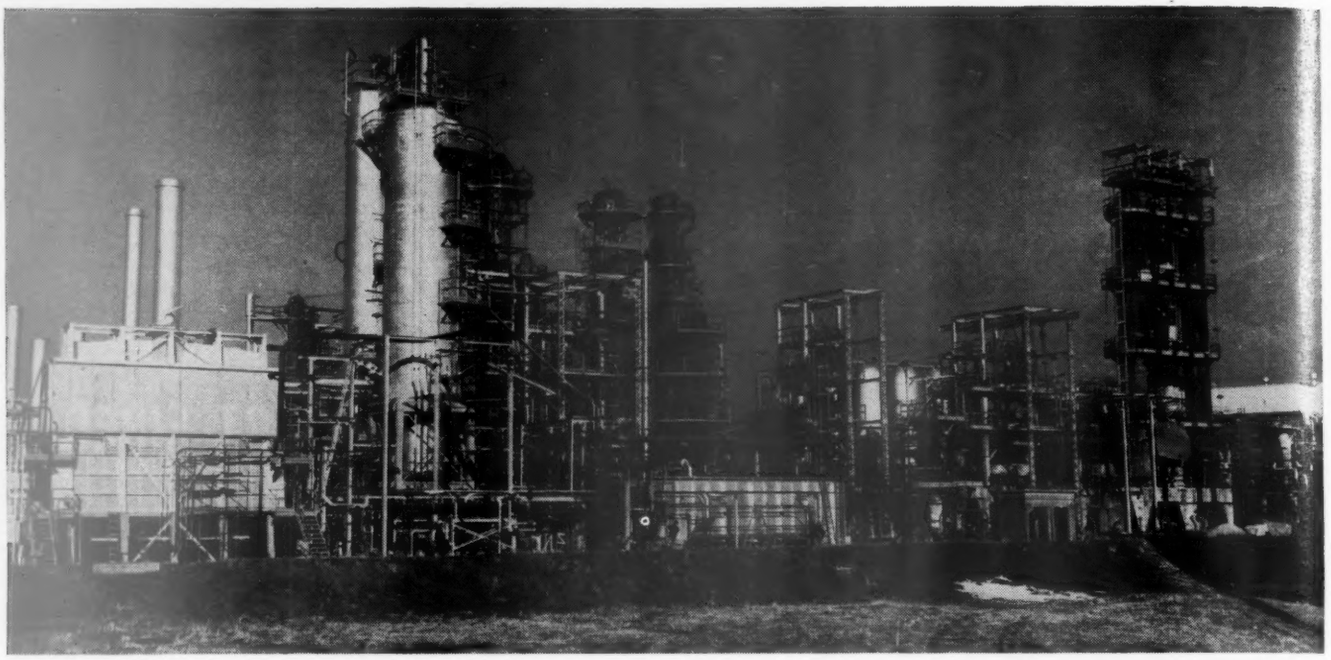


Kansas City refinery of Phillips Oil Company, showing a portion of fractionating towers and other equipment.

Phillips Lube Plant on Stream

Equipped with the most recent developments in processes, the new lubricating oil plant of Phillips Oil Company in Kansas City, Kansas, has gone on stream to produce more than 2000 bbl per day of oils of all types and specifications to meet the postwar requirements for lubricants. Included in this plant is a "day after tomorrow" canning unit, for packaging oils, with the most up-to-date automatic machinery for making, filling, and sealing cans of the required sizes and types.

Approximately 200 employes are needed to operate the plant properly. The system includes a revamped crude distillation unit which supplies a mixture of topped Oklahoma crudes fractioned into light, medium, medium-heavy, and heavy streams distilled under high vacuum. Propane is employed to deasphalt these various fractions, separately. The deasphalted fractions then are treated with phenol as a selective solvent, to remove the more soluble and less desirable portions of the oil, which do not make good lubricants. The viscosity index of the extracted oil may be controlled within wide limits, by the amount of phenol solvent used. Phenol was chosen as the selective solvent after thorough study of the problem, and was found to be the best single solvent available for treating the several streams of differing viscosities, that the plant must process.

Propane is used also to remove wax from the extracted oil. Self-refrigeration by evaporation of a part of the propane added, cools the oil to about 50 F. below zero, and the crystallized wax is removed in continuous rotary filters. Here again the pour point of the finished oil is controlled by the amount of solvent used, and by the temperature to which it is chilled.

Finally the dewaxed, and extracted, and deasphalted oil is filtered through 'clay,' or fullers earth or the equivalent, to clarify it and to remove undesired color to meet predetermined standards. The clarified and filtered oil fractions are blended in the blending and packaging unit, to specifications for viscosity, etc., and additional agents are included to improve various properties required of premium quality oils. The accompanying photo shows the entire plant as it is now being operated.

Begin Operations

The Douglas Oil Company of California began operations recently in their new barreling plant, located at their Clearwater, California, refinery. Capable of barreling 2000 bbl in twelve hours this plant was built expressly for Douglas export products, principally asphaltic materials. The filled barrels are transported directly from the Douglas refinery to dockage at Los Angeles Harbor. L. A. Whitlock, Douglas director of refining, is in charge of all plant operations.

Gas Course Speakers

Speakers for the general assemblies of the Fourth Annual Short Course in Gas Technology, held in Kingsville, Texas, were R. H. Hargrove of Shreveport, Louisiana, president of the Texas Eastern Transmission Corporation, and Richard M. Kleberg of Kingsville, chairman of the board of directors of the King Ranch.

Sponsored by the Southern Gas Association, the course was presented by Texas A&I College for the fourth consecutive year. Dr. Frank H. Dotterweich was administrative committee chairman.

Magnolia Builds Cycling Plant

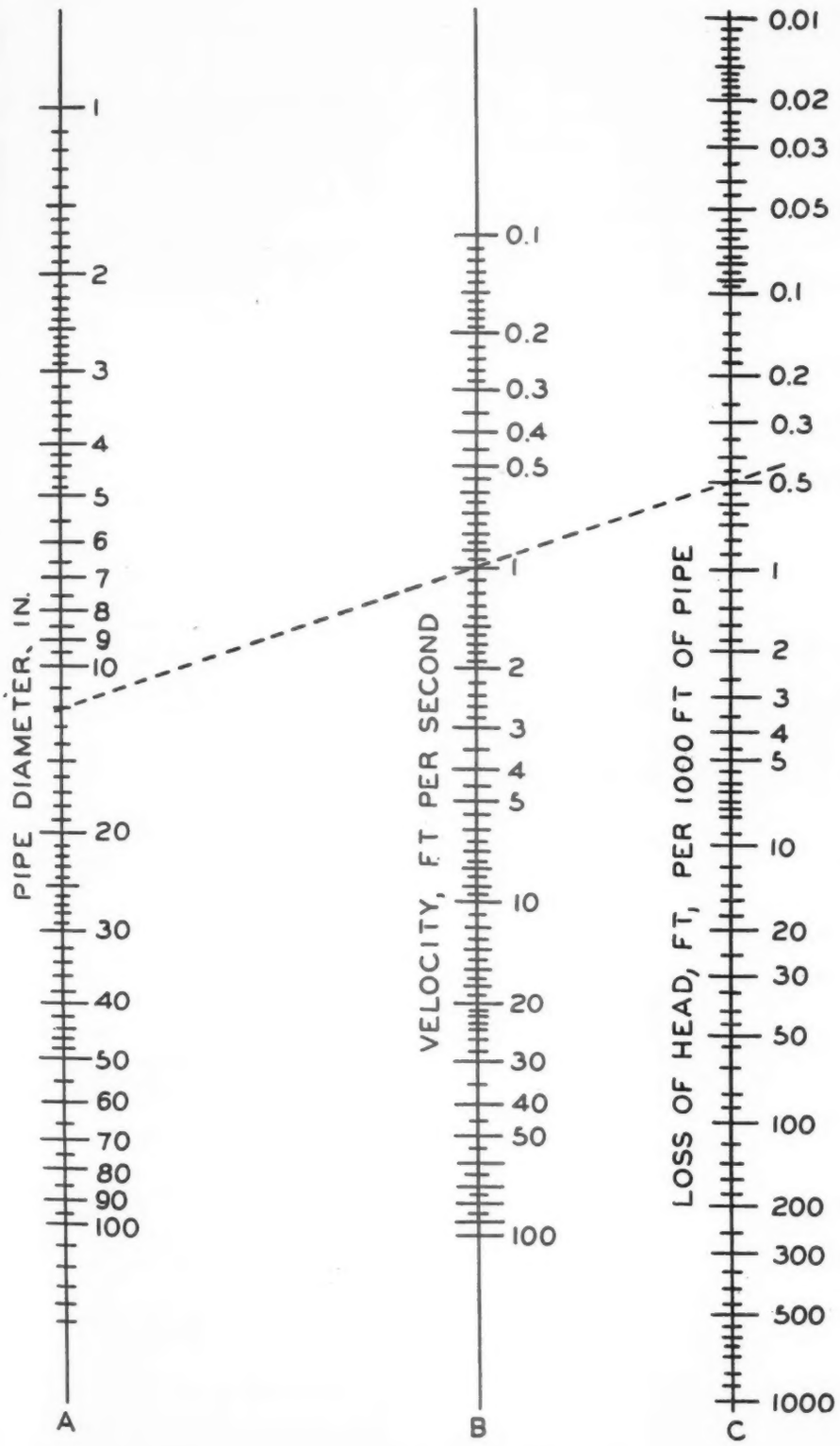
Contract has been awarded to Construction Service Company, Houston, Texas, for Magnolia Petroleum Company's new pressure maintenance and cycling plant for the deep Chitwood pool of Grady County, Oklahoma.

Temporary construction has already begun, with engine-compressor units having already been delivered to the plant site. The plant will be on the Drummond lease in the southwest quarter of section 34-5n-6w, near the center of the Chitwood field, 7 miles southwest of Alex, Oklahoma.

The new plant will have four 880-hp compressor units, capable of handling 37,750,000 cu ft of natural gas per day. After processing the field gas, the residue will be returned to the three producing sand zones in the field. Completion of the project is expected sometime in December.

PLANT AIDS

CHART TO COMPUTE DIAMETER OF PIPE.



Loss of Head in Pipes

To compute the diameter of a pipe which is large enough to offset the loss of head due to scale, rust and other interfering obstructions in the pipe after continued use, the empirical formula available is somewhat difficult to apply. The accompanying chart enables the engineer to arrive at such computations without much of the difficulty attending the use of the formula.

The chart is based on the formula; it gives the relationship between the actual internal diameter of the pipe in inches and the linear flow velocity of water in feet per second. For example; the dotted line across the chart shows that, with 12-inches internal diameter in Column A, and water velocity is one ft per sec, Column B, the loss of head is 0.5 ft per 1000 ft of pipe, Column C. The chart can be used with any two of the three variables known, to find the third one quickly and with satisfactory accuracy.—W.F.S.

Lantern Ring for Oil Pump

A pump operating with a catalytic cracking unit, handling a slurry of catalyst and oil, cut out its gland packing and had to be repacked every two weeks. A special lantern ring was placed in the bottom of the stuffing box of a Byron-Jackson Type B-M two-in. pump, after being drilled to allow a small amount of mid-circulating oil to 'leak' in to the packing box. This circulating oil is at a higher pressure than is the oil-catalyst slurry in the body of the pump, consequently no catalyst can get into the gland to cut out the packing; a slight amount of oil leaks into the cylinder which causes no harm whatever. Now the gland needs repacking about twice per year. —(D. O. Mayfield).

Lines on Compressors

Because of sometimes serious, and always appreciable vibration in heavy duty compressors, 1-in. steel vent lines continue to break frequently. The problem can be solved by installing flexible metal lines on these vents from the compressor discharge, so that each one is connected to a common header. This solution has practically ended vent line breakage, and reduces downtime, for that reason practically to zero.—(Tucker-Fenley).

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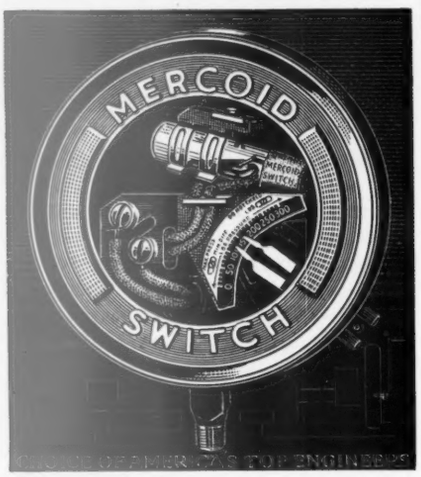

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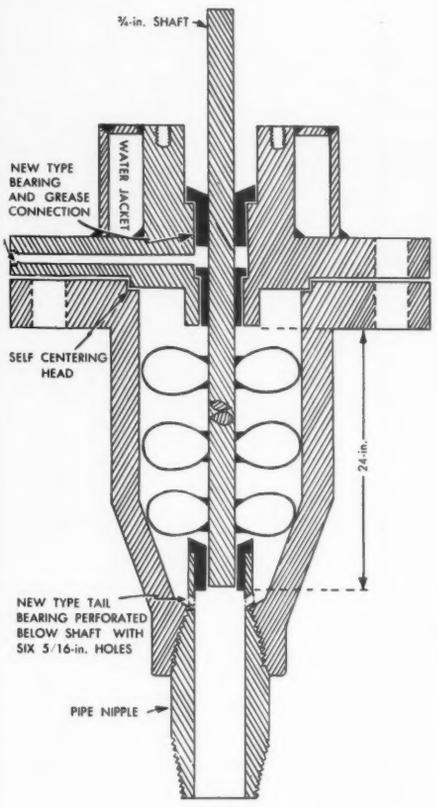
PLANT AIDS

Improving Lab Stirrers

The apparatus is divided into three parts, as shown in the drawing.

(1) An extra heavy flange is used as the base of the upper part of the treater-mixer assembly such as is used in laboratory batch treating of heavy oils. A small hole is drilled radial-wise through the flange to the center, is threaded to receive a connecting male fitting to attach the lubricator line for conveying lubricant to the packing gland; a stuffing box is used, with the packing space connecting to the lubricant inlet hole.

(2) Self-centering treat unit head. The face of the flange discussed in (1) above is faced off to lave a shoulder, as indicated; a slot is machined correspondingly in the other flange of the assembly to receive the male shoulder on the removable flange. In this manner the stirrer, inset in the movable flange, is always centered in the

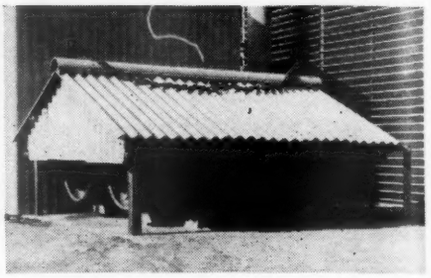


mixer, and propeller-mixer blades do not touch the sides of the container.

(3) Tail bearing for mixer shaft. To prevent shaft wabbling and whipping, a sleeve or cylindrical bearing, perforated below the bearing portion with six or more holes of desired size, is fitted and threaded into the apex of the cone of the mixer body. These holes are for draining the contents of the treater. This bearing drain attachment may be made from a pipe nipple and the bushing of brass or other metal. For heavy oil treating the oil in the treater serves to lubricate this bearing.—(W. A. Mix).

Shade for Cylinders

When cylinders containing chemicals, chlorine, ammonia and the like,



are placed in an open area, the cylinders and the contents can be kept at atmospheric temperature with an adequate sun-shade. This sun-shade is made of steel and corrugated Transite as a matter of safety and for permanence. The framework is made of pipe and heavy angle iron, placing the rafters with sufficient slope for rapid run-off of rain. Four legs support the roof on a concrete pad without foundation bolts.

As both the sun-shade and the cylinders have weight greater than men can lift safely, they are handled and moved with a crane or a winch-equipped refinery truck. A chain bridle is attached to the sun-shade with flat steel loops welded to the ridge-pole and extending through the comb of the roof, to act as a sling in which the hook of the crane is attached for lifting.—M.H.P.

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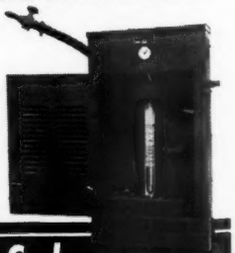

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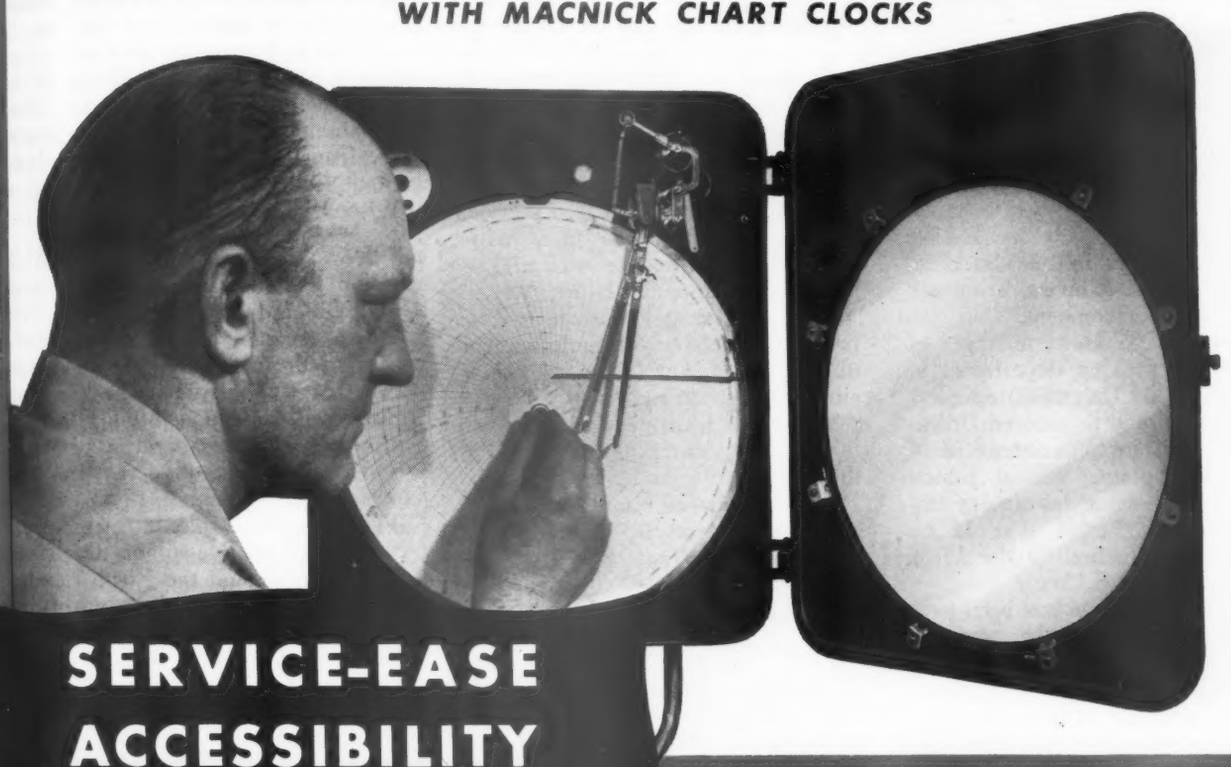

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PERSONALS

Several staff changes and promotions at the Shell Oil Company refinery in Martinez were announced recently by refinery manager John Tench.

John M. Brackenbury has been appointed superintendent of the Montreal refinery of Shell Company of Canada, Ltd. Brackenbury joined Shell in 1933 as a laboratory inspector at Wilmington refinery. Since that time he has held various technical positions in the company and last returned to Martinez in 1945 as chief technologist. In 1946 he was promoted to assistant superintendent.

Leonard T. Wilson, manager of the catalytic cracking department at the Wilmington, Delaware, refinery, has been appointed to succeed Brackenbury as assistant superintendent of the Martinez plant. Wilson joined Shell in 1933 as a laboratory inspector. During World War II he served with distinction in the Field Artillery of the U. S. Army.

J. D. (Don) Davis has been promoted to manager of the catalytic cracking department at Wilmington refinery. Davis first joined Shell in 1934 as a laborer in the Martinez plant, but prior to that he had served as an office boy in the Los Angeles office during school vacations. He is being replaced as department manager of the Gauging Department by **F. S. Hummel,** who is presently assistant department manager of the Refining Department. Hummel joined Shell in 1936 as a chemist in the control laboratory of the Martinez plant. In 1938 he was transferred as a technical assistant in San Francisco, California, office, holding that position until 1942 when he left on military leave to serve in the Air Service Command of the U. S. Army.

John J. Stanko has been appointed manager of the processing asphalt division of the Douglas Oil Company of California, W. G. Krieger, president, has announced. Stanko has spent some 15 years in the development of asphalt products. He was formerly the director of research of Flintkote Company in New York City.

T. G. Hughes was elected executive vice president and **B. W. Anthony** a director and secretary-treasurer of Oronite Chemical Company, subsidiary of Standard Oil of Ohio. Hughes, who went to work for Standard in 1926, has been with Oronite since its formation in 1943. Anthony is transferred from California Spray Chemical Corporation, another subsidiary, which he joined in 1943.

J. R. Carringer, vice president and assistant to the president of Esso Standard Oil Company, has retired after 45 years with the company. Carringer, whose career spanned the development of petroleum refining from simple distillation to modern catalytic cracking, entered the oil business at 17 as an apprentice in a tank car repair shop. In 1914, at the age of 28, he was associated with E. M. Clark in experimental pressure distillation leading to the Burton-Clark pressure still, forerunner of present-day "cat" cracking, which greatly increased the yield of gasoline from crude oil at a time when the automobile was making growing demands on the industry.

As a director and subsequently vice president in charge of manufacturing during World War II, he was responsible for the conversion of Esso's six refineries to wartime operations and the greatest output in the history of the company.

A former director and general manager of manufacturing, Carringer was named a vice president in 1943, and became assistant to the president earlier this year.

P. N. Gammelgard, operations manager for the refinery operating division of Pure Oil Company has been named commanding officer of the Volunteer Petroleum Reserve unit for the Ninth Naval District, and **Charles R. Haddon** of Socony-Vacuum Oil Company, Inc., was appointed executive officer.

Gammelgard succeeds **George H. Schultz,** vice president and treasurer of American Mineral Spirits Company, Chicago, Illinois, who organized the group.

Louis B. Wells has been appointed manager of Sun Oil Company's Marcus Hook Refinery succeeding Andrew W. MacMurtrie, who is retiring after 39 years with the company. Wells began work at the Marcus Hook Refinery in 1923, after having been employed at the Sun Shipbuilding and Dry Dock Company. He was named refinery superintendent in 1944, a position he held until his recent appointment.

Other appointments are: **Charles E. Maschal,** assistant manager, and **W. T. Askew,** superintendent of the refinery. Maschal joined Sun Oil Company as a still fireman at Marcus Hook Refinery in 1933. Born in Philadelphia, Pennsylvania, he is a graduate of Drexel Institute of Technology.

A graduate of Texas A. & M. College, Askew joined Sun Oil as a chemical engineer in the development division at Marcus Hook in 1931.

F. F. Diwoky has been named division gas superintendent for Stanolind Oil and Gas Company at Oklahoma City, Oklahoma. He will be responsible for the technical phase of the operation of Stanolind's refinery, natural gasoline, cycling and pressure maintenance plants in the division.

Prior to coming to Oklahoma City, Diwoky was project engineer in the manufacturing department in Tulsa, Oklahoma. He has degrees in chemistry from Oregon State College, Iowa State College and the University of Wisconsin.

J. W. Roach has been named division gas superintendent for Stanolind Oil and Gas Company at Fort Worth, Texas. John R. Evans, manager of the company's North Texas-New Mexico division announced. Roach will be responsible for the technical phase of the operation of Stanolind's natural gasoline, cycling and pressure maintenance plants in the division. These plants include the Slaughter gasoline plant near Sundown, Texas, and the North Cowden and South Fullerton plants now being built.

Prior to coming to Fort Worth, Roach was chief project engineer for the manufacturing department in Tulsa, Oklahoma.

The following changes have been made in the natural gas department of the Mangolia Petroleum Company:

John R. Ackenhausen has been transferred from plant foreman at Mamou, Louisiana, to district engineer of the Wewoka, Oklahoma, natural gas district.

William R. Stephens, plant foreman at the Kenova gasoline plant in the Union, Arkansas, district, has been transferred to the Mamou, Louisiana, gasoline plant in the Vanderbilt, Texas, natural gas district.

John E. Shannon, field foreman at Mamou, Louisiana, in the Vanderbilt, Texas, natural gas district, has been transferred to the Panhandle district's Hickok, Kansas, gasoline plant.

G. W. (Gerry) Jarvis, 42, chief engineer, refining department, McColl-Frontenac Oil Company Limited, died at Montreal General Hospital, Western Division, recently after a brief illness.

Born in Hamilton, Ontario, he was graduated from Queen's University. After spending two years as lecturer in the mechanical engineering department at Queen's, he joined the staff of McColl-Frontenac in 1934 and held various positions on construction and operations until 1943 when he was appointed chief engineer.

▸ **Dr. S. C. Ogburn, Jr.,** who last year joined Foote Mineral Company of Philadelphia, Pennsylvania, as manager of research and development was appointed a director of that firm at a recent stockholders meeting. After receiving his Doctorate from North Carolina in 1926, Ogburn spent several years as a member of the faculty of Washington and Lee University, as professor of chemical engineering of Bucknell University, and as project engineer, technical supervisor and research manager of the General Chemical Company, New York.

▸ **Don B. Pruess,** process engineer in the refining division of the Cities Service Oil has been transferred to the New York office of Petroleum Advisers, Inc., a subsidiary.

▸ The appointment of **Dr. Max H. Thornton** as chairman of the chemical research division at Midwest Research Institute is announced by Dr. George E. Ziegler, director. As head of the chemical research division, Dr. Thornton will administer research in all branches of chemistry. He joined the staff of the Institute in 1945 during the first year of its operations. He received his Ph.D. at Purdue.

▸ **J. V. Stevens,** head of refinery stores for Mid-Continent Petroleum Corporation, resigned May 1, to enter business for himself.

Floyd F. Wick, former buyer in the Tulsa, Oklahoma, materials and purchasing department, succeeds Stevens.

▸ **Alan E. Hall** has been appointed superintendent and **Harold G. Russell** assistant superintendent of the research and development department of The Bahrein Petroleum Company, Limited at their Bahrein, Persian Gulf refinery.

Hall replaces George S. Windle who has been transferred to the New York office of California Texas Oil Company, Limited.

▸ **E. A. Renfro** has been named division gas superintendent for Stanolind Oil and Gas Company at Houston, Texas.

In the newly created post, Renfro will be responsible for the technical phase of the operation of Stanolind's natural gasoline, cycling and pressure maintenance plants in the division. A veteran Stanolind employe, he has been with the company since 1934.

▸ **S. J. (Stan) Gardner** has joined Husky Refining Company as traffic manager. Former traffic manager for Western Oil and Fuel Company, Minneapolis, Minnesota, Gardner's experience has been principally in traffic management. He studied engineering at the University of Minnesota.

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MARKETED PRODUCTION OF LIQUEFIED PETROLEUM GAS

Year	Total sales		Distribution—1000 gallons annually							
	Thousand gallons	Per cent increase	Domestic†	Per cent increase	Industrial and misc‡	Per cent increase	Gas mfg	Per cent increase	Chemical mfg	Per cent increase
1922	223	...	Sale of liquefied petroleum gas confined primarily to bottled gas business prior to 1928							
1923	227	24.4								
1924	376	36.0								
1925	404	7.2								
1926	465	15.2								
1927	1,091	134.6	...	...						
1928	4,523	314.6	2,600	...	400	...	1,500	...	...	...
1929	9,931	119.6	5,900	126.9	1,500	275.0	2,500	66.7	...	...
1930	18,017	81.4	11,800	100.0	2,200	46.7	4,000	60.0	...	...
1931	28,770	59.7	15,295	29.6	7,172	226.0	6,303	57.6	...	...
1932	34,115	18.6	16,244	6.2	8,167	13.9	9,703	53.9	...	...
1933	38,931	14.1	16,626	2.3	13,987	71.3	8,318	−14.3	...	...
1934	56,427	44.9	17,681	6.3	32,448	132.0	6,298	−24.3	...	...
1935	76,855	36.2	21,380	20.9	47,894	47.6	7,581	20.4	...	...
1936	106,652	38.8	30,014	40.4	67,267	40.4	9,371	23.6	...	...
1937	141,400	32.6	40,823	36.0	62,610	*	11,175	19.3	26,792	...
1938	165,201	16.8	57,832	41.7	62,694	0.0	12,386	10.8	32,299	20.5
1939	223,580	35.3	87,530	51.4	93,723	49.4	15,435	24.6	26,892	−16.7
1940	313,456	40.2	134,018	53.1	124,482	34.5	20,285	31.4	34,671	29.0
1941	462,852	47.7	220,722	64.7	172,669	38.6	25,255	24.5	44,206	27.5
1942	585,440	26.5	303,857	37.3	197,149	14.3	31,366	24.2	53,038	20.0
1943	675,233	15.3	344,962	13.7	237,396	20.2	37,519	19.6	55,356	4.4
1944	898,071	33.0	445,617	29.0	254,590	7.3	45,879	22.3	151,985	175.0
1945	1,067,979	19.0	533,262	19.7	256,577	0.8	53,849	17.4	224,291	47.5
1946	1,415,840	32.6	776,150	43.7	255,375	— 0.5	86,660	61.0	307,655	37.2
1947	1,845,000	30.3	1,010,000	31.8	285,000	11.6	135,000	55.8	415,000	34.9

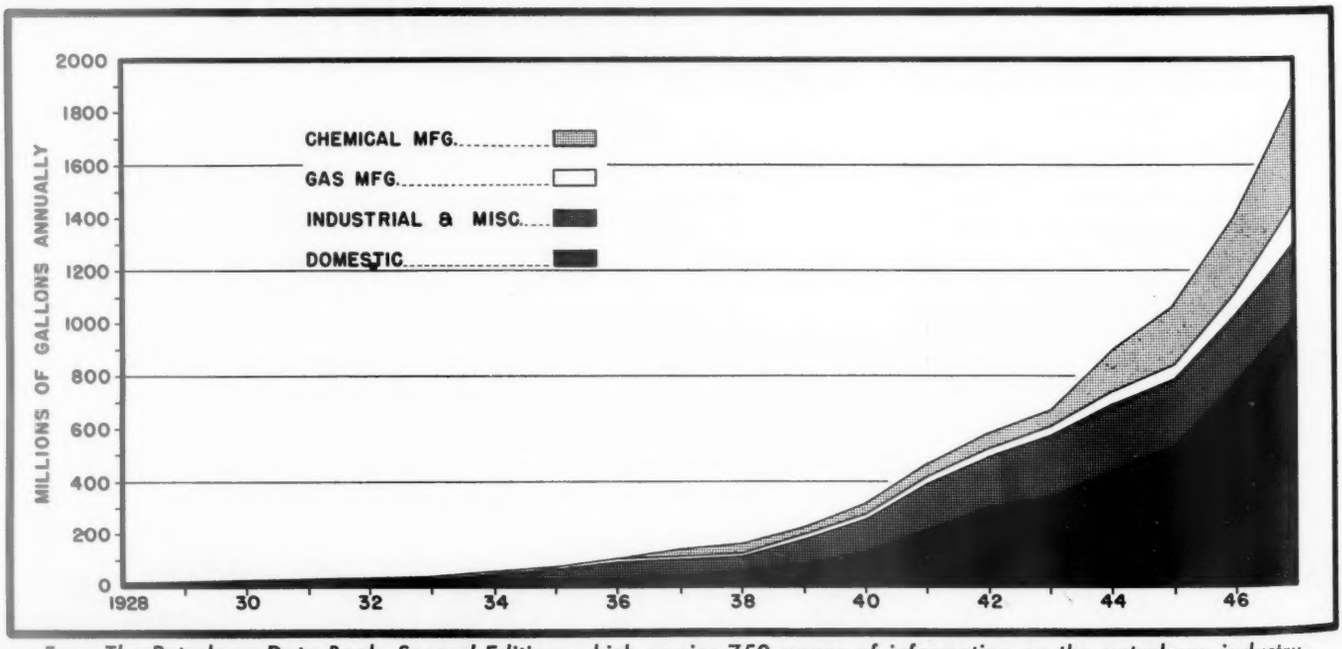
*Not comparable due to segregation of chemical manufacturing.

†Household use plus other requirements by these customers such as irrigation pumping, tractor fuel, flame weeding, chicken brooding and similar uses. Included also is LP-Gas sold by domestic distributors but used for industrial purposes, internal combustion engine fuel, and for gas manufacturing purposes.

‡Includes LP-Gas sold for fueling internal combustion engines.

Remarks: In this table "Total sales" for all years except 1947 were obtained from U. S. Bureau of Mines reports. "Distribution" for the years 1931 to 1946, inclusive, was obtained from the same source. All other volumes were estimated by K. W. Rugh and R. W. Thomas. The total sales volume includes all liquefied petroleum gases (propane, butane and propane-butane mixtures) when sold as such. Until 1944 the sale of pentane when sold for any purpose other than motor fuel blending was included; since then it has been excluded. Nor is butane included when blended with heavier petroleum fractions for motor fuel purposes. Intercompany sales transactions, such as purchases of liquefied petroleum gases by one company from other companies and resold as liquefied petroleum gases, have been eliminated in order to avoid duplication of sales figures. The data does not reflect sales of liquefied petroleum gases used directly by the producer at the point of production for fuel, polymerization, solvent de-waxing, etc. Neither do the figures include sales of hydrocarbons to plants manufacturing synthetic rubber or aviation gasoline or their components.

Source: U. S. Bureau of Mines; R. W. Thomas, Manager, Research and Development Department, Phillips Petroleum Co., and K. W. Rugh, Manager, Philgas Division, Sales Department, Phillips Petroleum Co.



From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.

REFINERS' MARGIN, MID-CONTINENT AREA—1947 BY MONTHS

Month	Gasoline				Kerosine			
	Per cent yield	Gal per bbl of charge	Price ¢ per gal (reg grade)	Value $ per bbl of charge	Per cent yield	Gal per bbl of charge	Price ¢ per gal (41°–43° Gr WW)	Value $ per bbl of charge
January	46.25	19.43	7.10	1.380	6.13	2.57	5.82	0.150
February	46.40	19.49	7.10	1.384	6.73	2.83	5.82	0.165
March	45.74	19.21	7.69	1.477	7.47	3.14	6.46	0.203
April	45.77	19.22	8.13	1.563	7.51	3.15	6.93	0.218
May	45.75	19.21	8.13	1.562	7.30	3.07	6.93	0.213
June	45.66	19.18	8.13	1.559	6.31	2.65	6.93	0.184
July	45.97	19.31	8.17	1.578	5.77	2.42	6.94	0.168
August	45.37	19.06	8.49	1.618	5.51	2.31	7.20	0.166
September	45.44	19.08	8.55	1.631	5.46	2.29	7.25	0.166
October	45.54	19.13	8.78	1.679	5.81	2.44	7.50	0.183
November	45.90	19.28	9.13	1.760	6.29	2.64	7.75	0.205
December	45.79	19.23	10.13	1.948	6.79	2.85	8.85	0.252

Month	Gas oil and distillate fuel oil				Residual fuel oil			
	Per cent yield	Gal per bbl of charge	Price ¢ per gal (No. 1 W and No 2 straw 36°-40° gr)	Value $ per bbl of charge	Per cent yield	Gal per bbl of charge	Price ¢ per gal (14°-16° gr)	Value $ per bbl of charge
January	13.64	5.73	5.18	0.297	20.63	8.66	3.31	0.287
February	13.51	5.67	5.13	0.291	19.68	8.27	3.31	0.274
March	13.53	5.68	6.00	0.341	19.16	8.05	3.62	0.291
April	13.06	5.49	6.38	0.350	19.13	8.03	3.93	0.316
May	13.65	5.73	6.38	0.366	19.15	8.04	4.24	0.341
June	13.71	5.76	6.38	0.367	19.45	8.17	4.79	0.391
July	13.63	5.72	6.48	0.371	19.15	8.04	4.83	0.388
August	14.05	5.90	6.78	0.400	20.03	8.41	4.83	0.406
September	14.69	6.17	6.88	0.424	19.06	8.01	4.83	0.387
October	14.70	6.17	7.03	0.434	19.93	8.37	4.95	0.414
November	14.88	6.25	7.50	0.469	19.99	8.40	5.24	0.440
December	14.63	6.14	8.04	0.494	20.27	8.51	5.83	0.496

Month	Lubricating oil				Other products			
	Per cent yield	Gal per bbl of charge	Price ¢ per gal (200 vis-600SR)	Value $ per bbl of charge	Per cent yield	Gal per bbl of charge	Price ¢ per gal (Average)	Value $ per bbl of charge
January	2.96	1.24	18.05	0.224	8.42	3.54	2.92	0.103
February	2.88	1.21	18.00	0.218	8.72	3.66	2.97	0.109
March	2.96	1.24	18.38	0.228	8.92	3.75	2.90	0.109
April	3.19	1.34	19.00	0.255	8.85	3.72	2.92	0.109
May	3.07	1.29	18.88	0.244	9.15	3.84	2.94	0.113
June	2.84	1.19	18.75	0.223	9.74	4.09	2.94	0.120
July	2.80	1.18	18.75	0.221	10.30	4.33	3.04	0.132
August	2.79	1.17	18.75	0.219	10.21	4.29	3.00	0.129
September	2.92	1.23	18.75	0.231	10.24	4.30	3.23	0.139
October	2.95	1.24	18.94	0.235	9.05	3.80	3.04	0.116
November	2.90	1.22	20.13	0.246	8.13	3.41	3.20	0.109
December	2.93	1.23	20.90	0.257	7.93	3.33	3.07	0.102

Month	Total value realized	Price 36° gr crude oil at well	Refiners' margin	Ratio
	$ per bbl of charge	$ per bbl	$ per bbl of crude oil run	Price per bbl of crude oil to price per gal of gasoline
January	2.44	1.62	0.82	22.8
February	2.44	1.62	0.82	22.8
March	2.65	1.79	0.86	23.3
April	2.81	1.87	0.94	23.0
May	2.84	1.87	0.97	23.0
June	2.84	1.87	0.97	23.0
July	2.87	1.87	1.00	22.9
August	2.94	1.87	1.07	22.0
September	2.98	1.87	1.11	21.9
October	3.06	1.97	1.09	21.3
November	3.23	2.07	1.16	22.7
December	3.55	2.47	1.08	24.4

From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.

At the AIChE speakers' table: Left to right, R. L. Huntington, University of Oklahoma; W. I. Burt, Goodrich Rubber; C. R. Ringham, Phillips Petroleum, co-chairman; G. G. Brown, University of Michigan; W. L. Nelson, University of Tulsa; F. J. Curtis, president of AIChE and vice president of Monsanto; M. E. Spaght, speaker, president of Shell Chemical; L. W. Bass, U. S. Industrial Chemicals; H. Grekel, Stanolind, co-chairman; T. H. Chilton, Du Pont; L. K. Cecil, Infilco, chairman of Tulsa section; S. L. Tyler, executive secretary.

Chemical Engineers Point the Way

We have and will continue to have a devalued dollar, when measured by former standards, F. C. Broach, vice president of the National Bank of Tulsa, Oklahoma, told the assembled Institute of Chemical Engineers in that city, May 8-11. As technological advances are continued, the value of the dollar will be increased, however, as this process goes on, the increasing cost of building and production tends to put up a ceiling beyond which industry cannot go. Most wars have been financed by money devaluation, in one fashion or another, and World War II is no exception, Broach stated.

Financing of industry's ventures is done, habitually, by the investment of savings from many sources, according to John Happel of New York University and Robert S. Aries, head of the Aries consulting engineer firm of New York. Expansion of industry and the reduction of unemployment can come only if money continues to flow into industry's coffers to finance new or expanded projects. If taxation stifles the opportunity for profits commensurate with the risks involved, then risk money will not venture into industry, which then stagnates, 'drying up the stream of new enterprise.'

A single, 10,000-bbl-a-day synthetic gasoline plant, though small in the eyes of the industry in gasoline produced, will also make as by-products, 7 per cent of the country's ethyl alcohol, 9 per cent of its acetic acid, 3 per cent of its acetone, and nearly 7 per cent of the methyl ethyl ketone required by the U. S. now, say T. Q. Eliot, C. S. Goddin, Jr., and B. S. Pace of Stanolind Oil and Gas Company, in talking about synthetic gasoline plant developments. This amount of gasoline is only 0.2 of one per cent of our gasoline needs; therefore any great production of synthetic gasoline will flood the country with other chemicals which will be available for any number of uses, these engineers said. Stanolind has suspended operations on the proposed synthetic gasoline plant planned for southwestern Kansas in the huge Hugoton gas field, but has contracted to handle the chemical products from the Carthage Hydrocol synthetic gasoline plant now building near Brownsville, Texas.

The chemical division of Cities Service Oil Company pioneered the now very rapidly growing petroleum chemical field, when it built the natural gas oxidation plant at Tallant, Oklahoma, and later units at other places. From this plant has come methanol, acetone, formaldehyde and mixtures of many alcohols, etc., employed as anti-freezes in the oil and automotive industries, as chemical intermediates, and for the multitudinous uses that modern gas started more than 20 years ago for removal of excess oxygen from natural gas lines. Growing recently at an unprecedented rate, the production of methanol alone last year totaled some 280,000 tons. Formaldehyde, basic chemical for resins, plastics and innumerable other finished products, was made to the extent of 350,000 tons, and its production, and needs, are literally growing daily with the expansion of American chemical industries. Other plants now operating or being built include that of Celanese Corporation, at Bishop, South Texas, McCarthy Chemical Company at Winnie, Texas, near Beaumont, and the Carthage Hydrocol plant.

Toluene is another of the basic chemicals in our present day industrial economy. Employed in huge quantities during the recent war as the basis for TNT this explosive, made from non-aromatic petroleum raw materials by the Hydroforming process, and other allied aromatics powered our bombs and airplane engines. Now, the Hydroforming plant of Humble Oil and Refining Company is being turned to peace uses to make higher octane number gasoline and special solvents for highly specialized applications, such as varnishes and lacquers, C. H. Marshall, chemical engineer with Humble, states.

Synthetic gasoline from natural gas can be manufactured in competition with petroleum sources, three chemical engineers from Standard Oil Development Company believe; they are E. V. Murphree, president, E. J. Gohr, and F. T. Bahr. Although the comparative cost of gasoline from natural gas is 12.5 cents per gallon compared to 14.5 cents for petroleum-derived gasoline, the consumer price is still in favor of the petroleum-based motor fuel, they said. We have enough tar sands and oil shale in this continent to supply us with fuels for 300 years at our present demand rate, these authors stated.

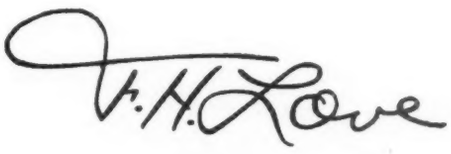
Many other subjects were discussed in detail during the four-day meeting devoted mostly to oil and gas technology. These subjects ranged from tonnage oxygen, being carried out in large plants now, to the conglomeration of finely divided carbon black by electrical methods now being applied commercially.

Petroleum Transportation Requirements

Although petroleum transportation facilities now in existence and under construction in the United States are adequate to meet present requirements and those of the immediate future, there will be need for continued increase in pipe line facilities to keep pace with an anticipated increase in petroleum production. The view that there will be greater demand for petroleum is based on indications that the domestic use of petroleum products will continue to increase at a substantial rate, as a result of accelerated output of motor cars, the trend of railroads to diesel motive power, and expanding use of fuel oil for residential and commercial heating.

Rate of increase in the use of petroleum products, however, is not the only factor that will determine the future adequacy of pipe line facilities. Another is the location of future petroleum reserves. Further, should the United States find it necessary or expedient to rely upon imports of crude oil in greater degree, the nature of transportation requirements will be somewhat different than if the source of supply is entirely domestic. In that event, the use of tankers would loom larger in the picture.

In any case, it has been estimated by one major oil company and included in a report made by the United States Department of Commerce on petroleum transportation that pipe line capacity must be increased by 333,000 barrels a day in 1949, 144,000 barrels a day in 1950, 155,000 barrels day in 1951, and 146,000 barrels a day in each of the succeeding four years.

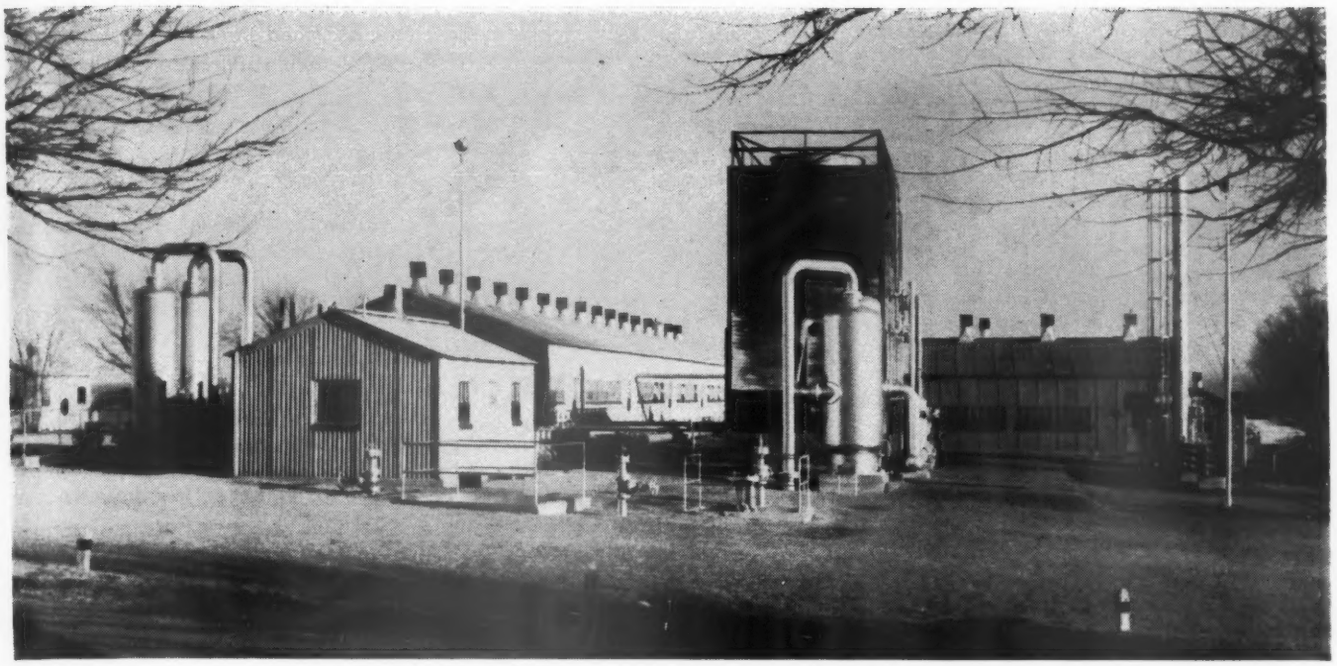


COROMAT PROVED UP TO 300% STRONGER BY ACTUAL FIELD TESTS BEFORE EXPERTS

TULSA, April 4—Before a group of 32 pipeline operators, engineers, and owners today, the new, stronger "Coromat"; the improved underground pipe wrap, was announced by Owens-Corning Fiberglas Corporation and demonstrated by their company engineers and by service engineers from Midwestern Engine & Equipment Co., Tulsa, Oklahoma, distributors of Coromat.

Owens-Corning experts explained that the new "Coromat" was developed to meet the need for an inorganic pipe wrap in longer length rolls than heretofore used by the industry and with increased tensile and tear strengths sufficient to allow application by "over-the-ditch" coating and wrapping machines at increased speeds and with fewer starts and stops.

The new "Coromat" material is as much as 300% stronger than conventional-type glass pipe wraps, has up to twice the resistance to transverse tear,



Lone Star Gas Company's Shamrock station into which field stations boost gas.

Design of New Compressor Stations

FRANK H. LOVE*

WITHIN the last several months the Lone Star Gas Company has constructed nine new compressor stations on its system in Texas and Oklahoma, as a result of which delivery capacity has been considerably increased in the areas involved. Five of the installations are field stations in the East Panhandle field and four are mainline stations. Of the latter two are for winter service only.

Various types of compressor units were selected. The individual selection of equipment and the design of the stations in general were based on factors that Lone Star management and engineering personnel considered made them best adapted to the specific function each had to perform. That the selections, both in design and equipment, were wise has been borne out by the efficiency of their performance in the short time these stations have been in operation. A description of the several stations follows.

The five stations in the East Panhandle field are for the purpose of boosting the pressure of gas from wells that have been producing for many years and as a result have declined in pressure. The compressors in all five stations operate in parallel and discharge into the common main suction line of Lone Star's Shamrock station. This station is on the company's 18-in. main transmission system to Wichita Falls, Ft. Worth, and Dallas, with a branch line taking off at Chillicothe.

Station A is designed to operate initially at 59-psi suction and 175-psi discharge pressure, under which conditions 20,500,000 cu ft of gas can be compressed a day. Provision has been included in the primary design to take care of later conditions when field pressure declines further. It is expected that eventually the station will operate at about 11-psi suction pressure and 90-psi discharge pressure. At these pressures the capacity will be 13,200,000 cu ft a day.

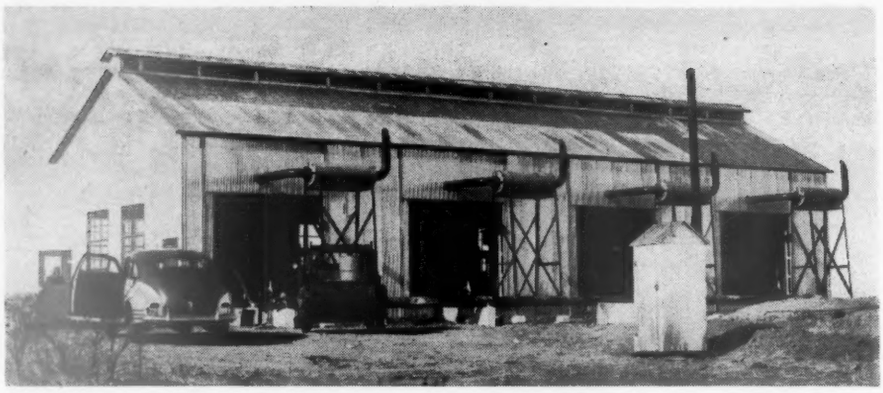
The equipment installed consists of four GMX-6 Cooper-Bessemer Turboflow compressor units each of 330 hp at 400 rpm, with provision made for aftercooling. The units have crank end unloading clearance pockets and speed controllers. Each machine has six 9¾ by 10½ power cylinders and three 13½ by 10½ compressor cylinders. The engines are internally piped by the manufacturer and have a complete radiator-fan type cooling system.

The air starting unit consists of a small gasoline engine driven air compressor and storage tank. A complete fuel regulating system, consisting of fuel regulators and surge drum, is provided.

There is one 6-ft diam cooling fan on each engine and one of the problems was to provide adequate air circulation without high air velocities inside the station building. The problem was solved by installing on the ridge of the roof a louvered air intake that extends the entire length of the compressor building. The louvers are adjustable from the floor. The building is designed as part of a basic block

*Editor, Pipe Line and Marine Transportation.

EXCLUSIVE



One of 5 field stations in East Panhandle field while still under construction.

plan, being made up of standard bays. Thus when it is desirable to add a compressor unit the end of the building can be knocked out and a block added, or, of course, as many blocks as desired. Another design feature is the provision that has been made to recirculate a part of the heated air to give building heat in the wintertime.

Power end of one of the compressor units at Benjamin station. There are two of these units, which are rated 330 hp at 400 rpm.

Station A, as well as stations B and C are the so-called Packaged units.

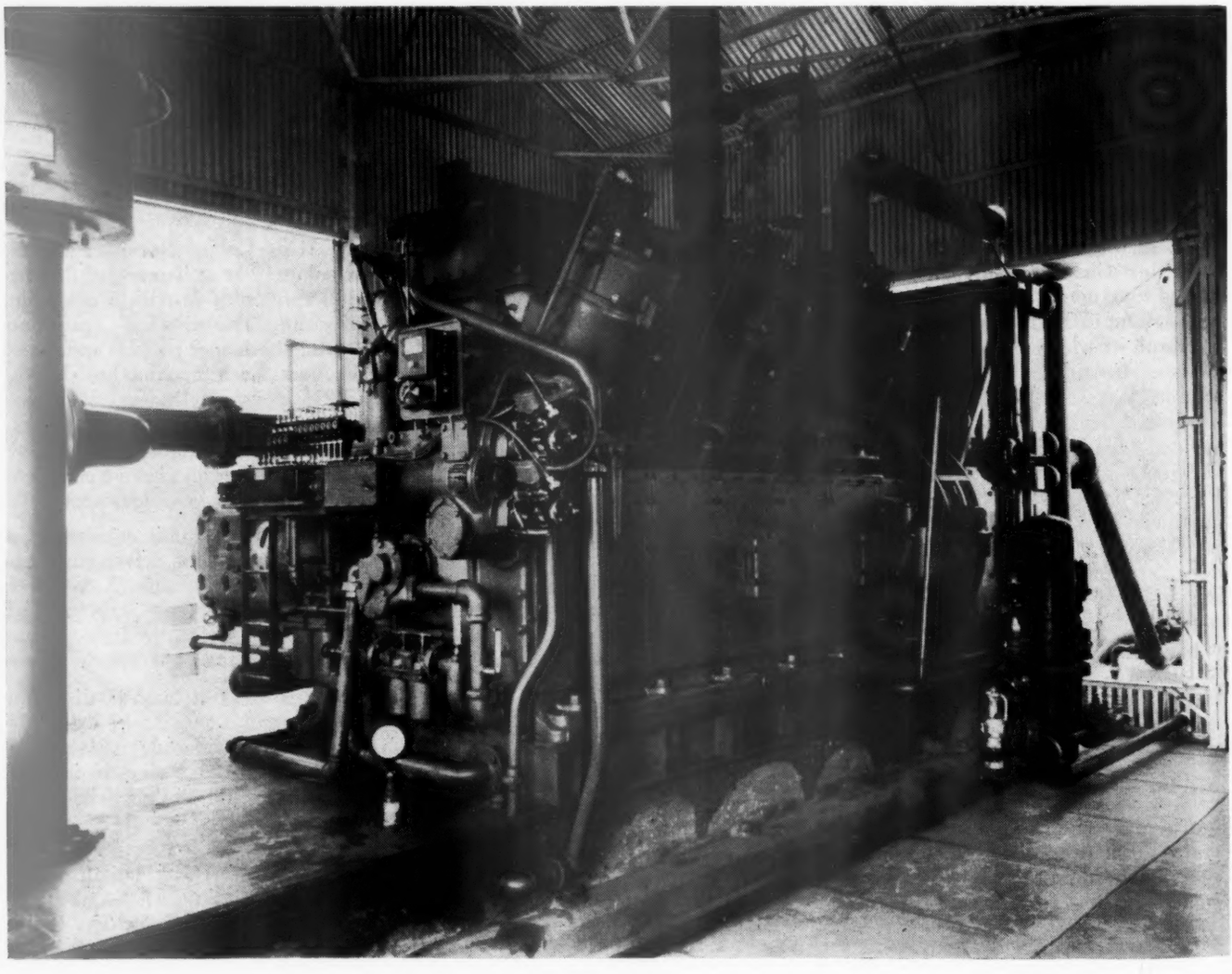
Station B has one 330-hp at 400 rpm and one 220-hp Turboflow compressors. The 330-hp unit has six 9¾ by 10½ power cylinders and three 13½ by 10½ compressor cylinders. Cylinders on the 220-hp unit are of the same size although there are only four power cylinders and two compressor cylinders. The same suction and discharge pressure conditions prevail as at Station A. The capacity at Station B, however, is 8,500,000 cu ft a day under high suction conditions and 5,500,000 cu ft under the low suction conditions that will exist some time in the future.

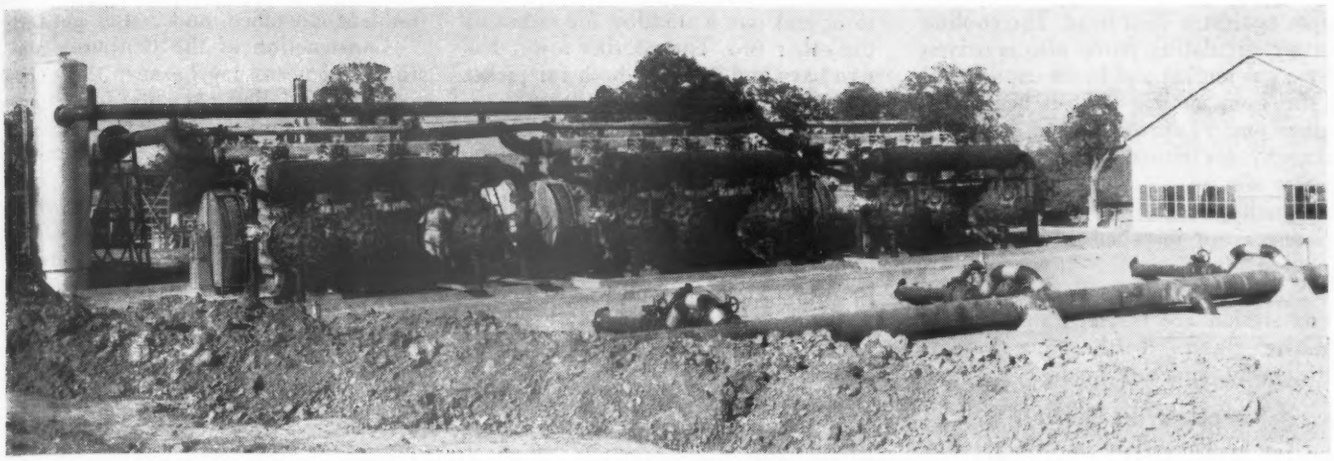
Station C consists of three Ingersoll Rand 8XVG-1 300-hp at 350 rpm units. Mounting of the compressors on skids and installation of the piping equipment to make the whole a packaged unit was done by J. B. Beaird Company, Inc. The units have four 11½ by 12 compressor cylinders. Design capacity at a pressure of 59 psi is 14,600,000 cu ft a day and at 11 psi will be 8,500,000 cu ft a day.

Station D has two Cooper-Bessemer vertical compressors rated at 50 hp at 500 rpm. Each is equipped with two 7½ by 9 power cylinders and one 8¼ by 9 compressor cylinders. The capacity at 59 psi is 1,450,000 cu ft a day and at 11 psi 930,000 cu ft a day.

Station E has the same equipment and the same capacities as Station D.

The installation of these five field stations makes possible an increase of 20,000,000 cu ft of gas a day into the Shamrock station.





At Fox, Oklahoma, three 880-hp compressor units were installed in a new station to operate in conjunction with a 6-unit older station.

The field stations are quite simple to operate. A crew of three supervise their operation and perform minor maintenance work for an 8-hr period in the day time. During the other 16 hr they operate without supervision. When extensive maintenance work is necessary a crew from the Shamrock station is called upon. Further, the stations have no lighting system, as they are generally attended only during daylight. A Homelight generating system is on hand, however, should it be necessary to make repairs at night.

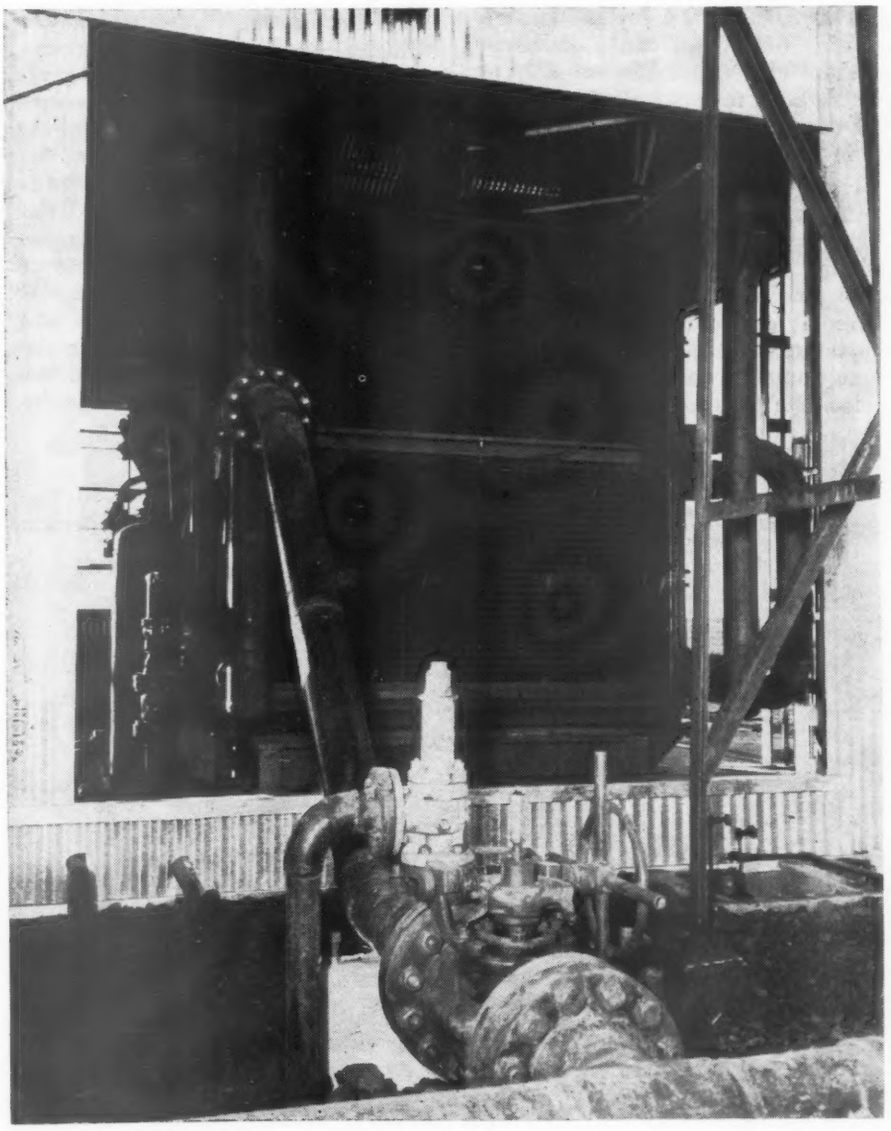
Fox Station

One of the new mainline stations is at Fox, Oklahoma, which was installed for the purpose of increasing delivery on the 12 and 16-in. line to Dallas. Lone Star already had an older station at Fox consisting of six units, which were boosting field gas against mainline pressure. Under the present setup three of these old units operate in parallel with three new units and the other three old units will boost gas into the discharge of these six units. The new units, however, are housed in a separate building from the old.

The new compressors are rated 880 hp at 300 rpm, each having eight 14 by 14 power cylinders and three 10½ by 14 compressor cylinders. These units boost the gas from a pressure of 150 psi suction to 400 psi discharge.

The total volume of gas handled by the station is 62,300,000 cu ft a day. Of this volume the new compressors handle 45,500,000 cu ft, the three old units operating parallel 9,600,000 cu ft. and the other three old units 7,200,000 cu ft.

Among the auxiliary equipment are two starting air compressors, one electrically driven and the other driven by a gas engine. An electric generating plant consists of one 50-kw and one 75-kw generators driven by 150-hp engines at 900 rpm. Jacket water cooling is with a fin-fan unit, the two fans being driven by small gas engines. Gas aftercooling is by means of gas coolers situated in the base of a 4-bay cooling tower. The jacket water circulating pump is an engine-driven unit having a capacity of 2400



Packaged units are equipped with an engine cooling system of radiator-fan type.

gpm against a 75-ft head. The cooling tower circulating pump also is driven by a gas engine and has a capacity of 1150 gpm against a 75-ft head. Another pump is provided that acts as a standby for either jacket or cooling tower service.

Finally, three 48-in. diam gas cleaners are installed in the station suction.

Sources of the gas handled by the Fox station are Doyle, Pauls Valley, White Bead, Robberson, Tussey, Ridgeway, and Fox fields.

Gainesville Station

The new station at Gainesville, Texas, is on the same mainline as the Fox station. Here, also, there was an existing station containing older type compressors. These were five in number. The new compressors are housed in a separate building and consist of two Cooper-Bessemer Turboflow units rated at 660 hp at 300 rpm. Each has six 14 by 14 power cylinders and two 11 by 14 compressor cylinders. The station parallels the operation of the old plant. The former has a capacity of 29,000,000 cu ft a day at a suction pressure of 175 psi and a discharge pressure of 360 psi. The capacity of the old compressors is 15,000,000 cu ft a day, giving a total station capacity of 44,000,000 cu ft.

Three 48-in. diam gas cleaners have been installed on the station suction. Jacket water and cooling tower circulating pumps have a capacity of 1650 gpm at an 80-ft head and are driven by gas engines with a continuous rating of 55 hp. There are three of these pumping units, one for jacket water, one for cooling tower circulation, and one a standby for either of the other two. The cooling tower has five bays and it serves both for jacket water cooling and gas aftercooling. The two 50-kw generators are driven by gas engines that have a continuous rating of 108 hp at 900 rpm. Two starting air compressors also are provided, one electrically driven, the other gas engine driven. To increase the water supply a well was drilled to a depth of approximately 300 ft, which supplies water at the rate of 22,000 gal a day.

The Gainesville station was installed for winter operation only. This is also principally true for the Fox station, except that in the latter case the units pulling on Fox field wells are also operated in the summer.

Benjamin Station

The Benjamin station is on an 8-in. line that branches at Chillicothe from the line having its origin in the Panhandle. There was no old station at this point and the new installation consists of two Cooper-Bessemer packaged units rated at 330 hp at 400 rpm. Each unit has six 9¾ by 10½ power cylinders and two 6¾ by 10½ compressor cylinders. At a suction pressure of 250 psi and discharge pressure of 500 psi this station will compress 14,680,000 cu ft of gas a day. For the most part the units are the same as those in the East Panhandle field, the difference being that certain changes have been made in them because of different size cylinders. The compressor building is of the same type and has the same features as those in the East Panhandle field. A cottage has been erected for the station superintendent, an office, and 3-stall garage.

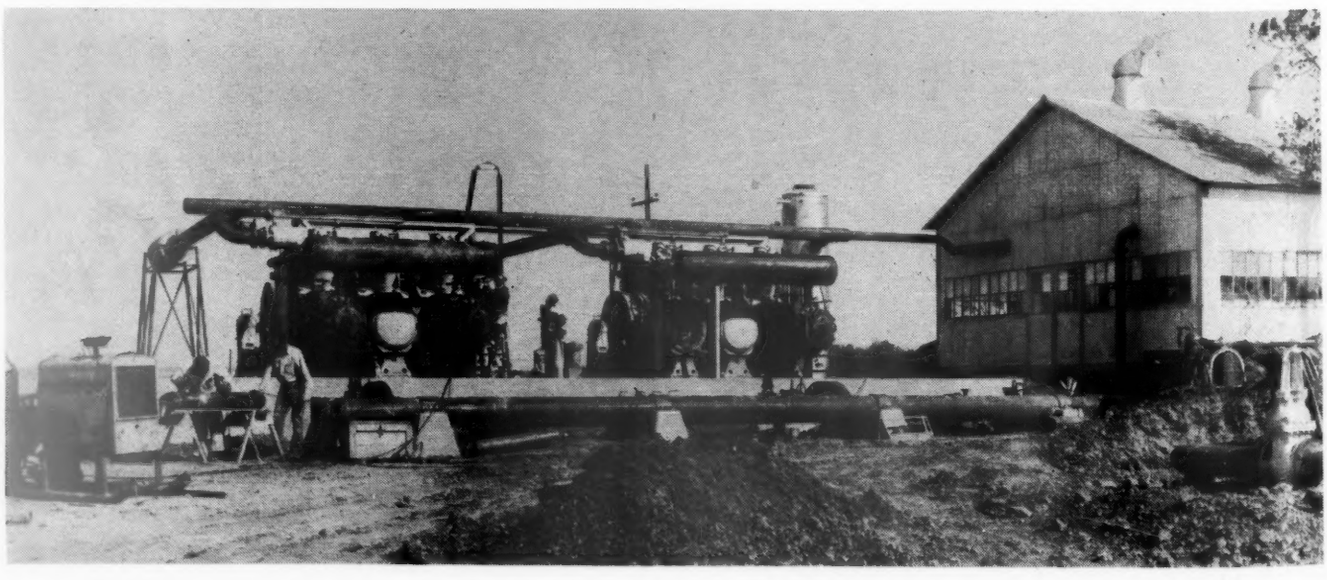
Construction of the Benjamin station was necessary because the company lacked line capacity for Stamford and Hamlin.

Groesbeck Station

On the section of the Lone Star system that takes gas from Long Lake, Grapeland, Buffalo, Navarro Crossing, and Red Lake fields, a station has been built at Groesbeck, Texas, which discharges through a 12-in. line toward Waco. At this station three Ingersoll-Rand 8-cylinder compressors have been installed. These units have 15¼ by 18 power cylinders and 11½ by 14 compressor cylinders. Suction pressure is 275 psi and discharge pressure 505 psi. At such pressures the capacity of the station is 62,200,000 cu ft a day.

Jacket water pumps, three in number, have a capacity of 1000 gpm each with a 75-ft head. The pumps are driven by 25-hp splashproof motors. The jacket water is cooled by a 2-fan fin-fan unit. The cooling tower is a 4-bay installation that has gas aftercooling as its sole utility. The two vertical cooling tower pumps have a capacity of 900 gpm each with a 40-ft head. A 190-kw generator direct connected to a 275-hp gas engine supplies electric power for the station. A standby generator unit consists of a 150-kw generator driven by a 240-hp V-12 engine. Other auxiliary equipment consists of two electrically driven starting compressors and three 48-in. gas cleaners. Three cottages have been constructed to house operating personnel, as well as an office building and a 4-stall garage. ★ ★ ★

Gainesville station under construction. New 2-unit station parallels the operation of an older station, a mainline booster.



Underground Storage of Propane-Air and Natural Gas Mixture

H. L. FRUECHTENICHT* and JOHN B. SIMPSON†

THE Michigan Gas Storage Company, a subsidiary of Consumers Power Company and Panhandle Eastern Pipe Line Company, normally receives large quantities of gas from Panhandle for storage in its gas storage fields in Clare County, Michigan, during the months from May to October, inclusive. It also receives gas in lesser quantities in April and November and that not needed for the daily demand of its customer is stored also. During the months of January, February, March, and December, a minimum of 25,000,000 cu ft per day is received from Panhandle and the balance of the daily demand is taken from the storage fields. At the present time, the Consumers Power Company is the only customer of Michigan Gas Storage Company, and its daily demand from Storage Company in addition to its own supply from ten Michigan fields varies from 20,000,000 cu ft per day in the summer to 100,000,000 cu ft per day in the winter. Michigan Gas Storage Company divides its year into two parts; namely, input cycle from April to November inclusive, and output cycle from January to March inclusive, and the month of December.

Early in 1948 it was estimated that 12,000,000,000 (billion) cu ft of gas had to be stored during the input cycle of 1948 in order to meet the requirements of Consumers Power Company during the 1948-49 winter season and to replace the cushion gas that had been withdrawn during the winter of 1947-48. Careful studies of the conditions in the storage fields showed that the fields should not be depleted below 375 psig without inviting probable damage to the reservoir; however, in order that service would not be curtailed and industry shut down during the winter of 1947-48 as it had been in other areas throughout the country, the Michigan Gas Storage Company elected to continue full

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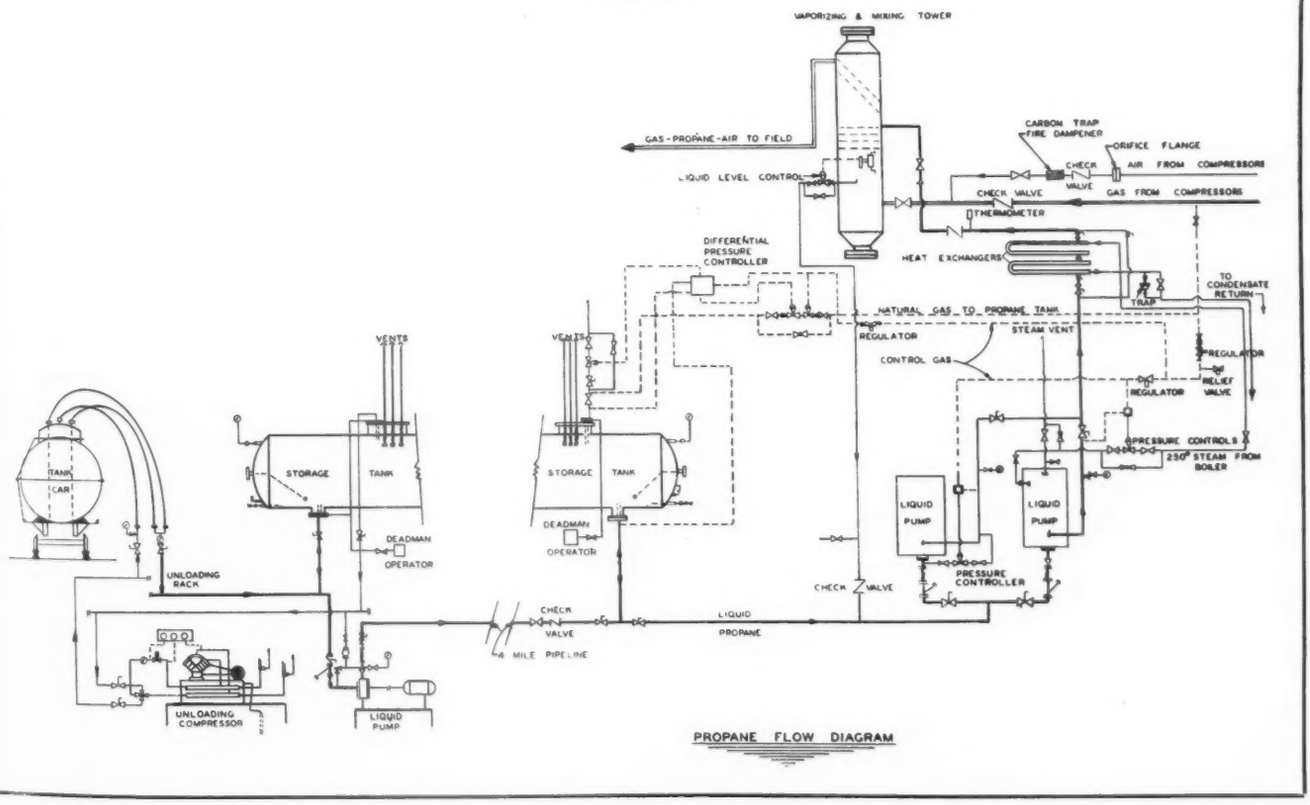
†Engineer.

FIG. 1.



PROPANE FLOW DIAGRAM

service to Consumers Power Company even though the pressure fell below 375 psig. As a result, the cushion was depleted to 334 psig.

In 1946 when it appeared that a natural gas shortage was inevitable, Consumers Power Company started restricting its markets by complete curtailment of new space-heating customers, and in September, 1947, all industrial customers were placed on a quota basis (use restricted to that consumed during previous 12-month period), and both of these restrictions are still in effect as of March 31, 1949.

The shortage of steel made it impossible to enlarge the facilities of both Michigan Gas Storage Company and Panhandle Eastern Pipe Line Company in order that full contract amounts could be delivered to, and received by, Michigan Gas Storage Company. The most optimistic view of the deliveries for storage expected during the 1948 input cycle revealed a probable shortage, in meeting the estimated market and cushion replacement requirements, in excess of 1,000,000,000 (billion) cu ft.

During the winter of 1947-48 when great demands were made upon the storage fields to avoid any curtailment of the restricted market served by Consumers power Company, an increased amount of water was recorded in the wells of the storage fields. This water encroachment became greater as the pressure fell below 375 psig. Although some damage may have been done to the storage fields when they were operating from 375 down to 334 psig, the time the fields were operating at this lower pressure was of short duration. Any damage done is not believed at present to be permanent.

Propane-Air Plant

In order to meet this anticipated deficit, engineers of Michigan Gas Storage Company and Consumers Power Company studied various methods of obtaining additional gas. Sources of natural gas in Michigan were limited and no new discoveries had been made for several years, which made it impossible to obtain additional local gas. Panhandle's capacity to make additional deliveries was found to be impossible at this time due to the material shortages already stated. High Btu oil gas to be made in several existing emergency stand-by plants was considered, but the shortage of oil and operating difficulties forestalled this plan. Installation of peak-shaving propane-air units at principal distribution points was also contemplated, but the cost, amounting to several million dollars, was prohibitive and material shotages in this type of equipment were acute. There finally emerged from the above studies a plan to build one propane-air plant at the storage fields, having a capacity of 10,000,000 cu ft per day of propane air, and mix propane-air gas with large amounts of natural gas and store the mixture underground. The plant could be built for approximately $250,000 because part of the necessary equipment, (compressors, boilers, and mixing tower), was installed and available for quick conversion. This plan offered continuous operation of the propane-air plant and a uniform mixture immediately available for use when needed.

As far as could be determined, mixing propane-air and natural gas for underground storage on such a large scale had never before been attempted, and some questions were raised as to recovery, vaporization, condensation,

FIG. 2.

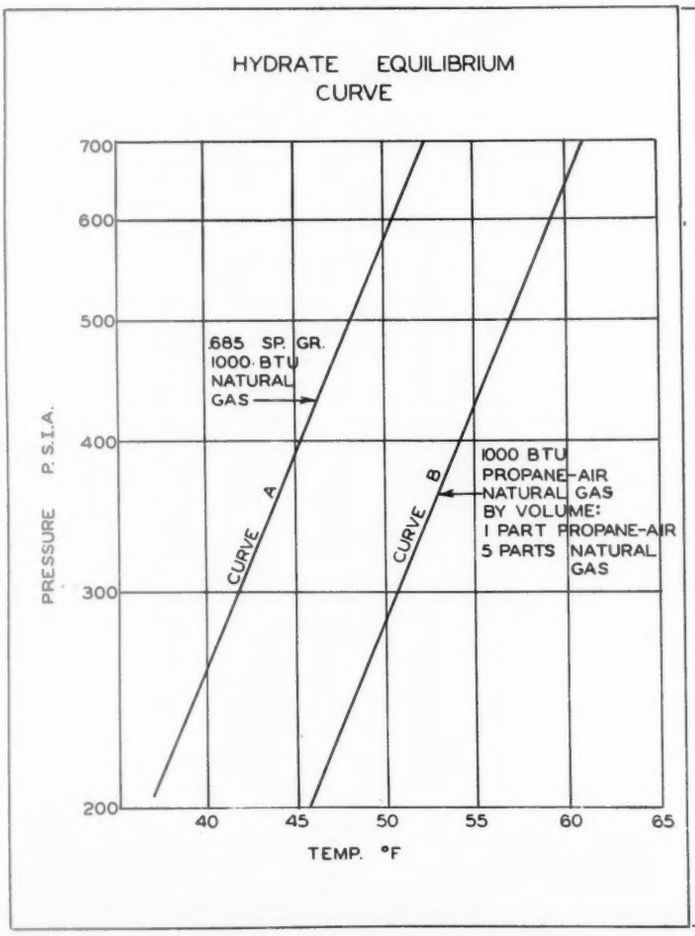
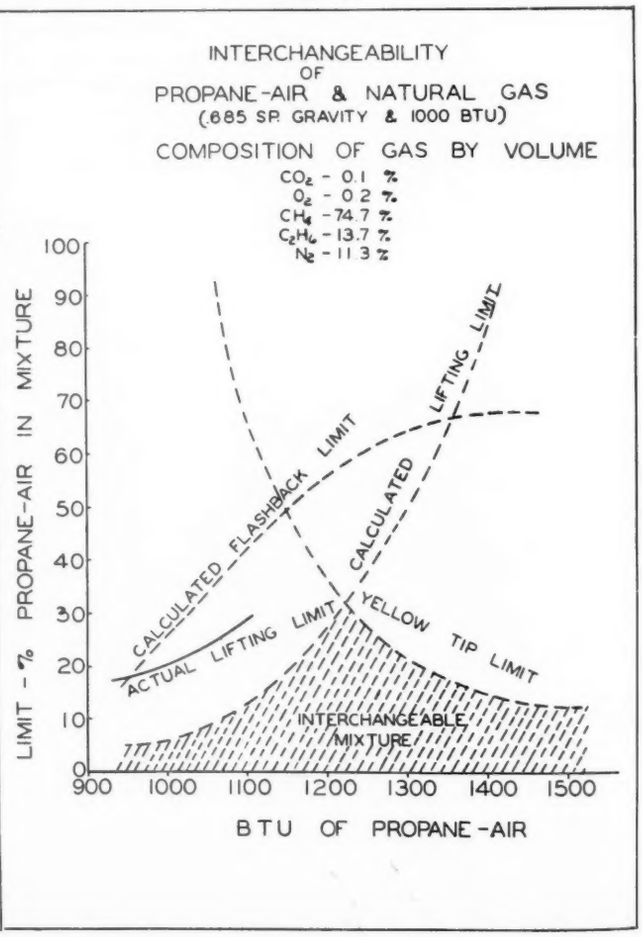
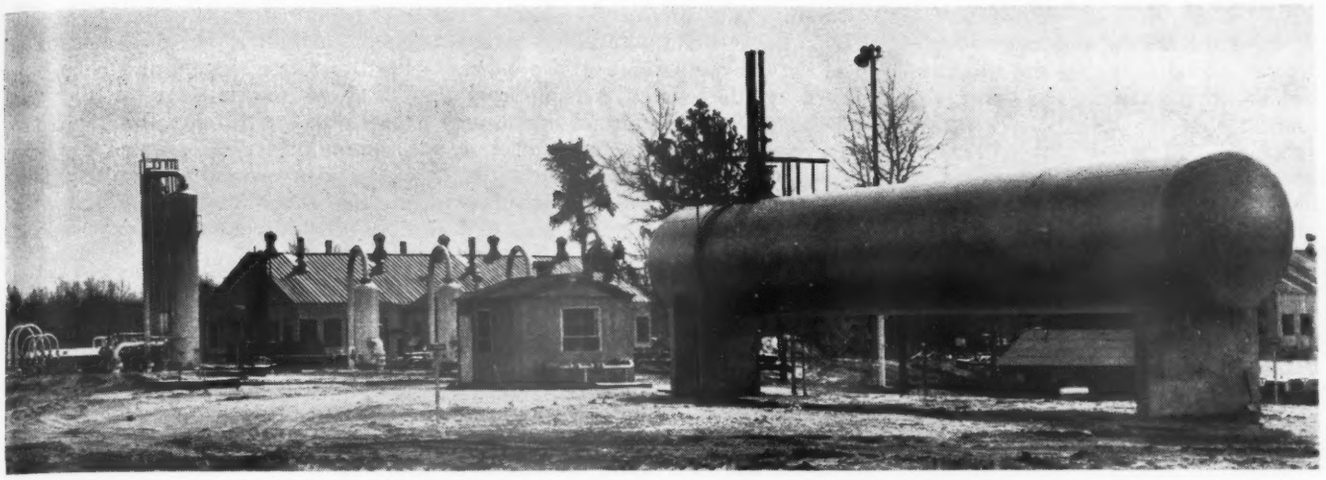


FIG. 3.





Mixing station showing storage tank and pump house in foreground and compressor building in background, with mixing tower to the left.

interchangeability, and hydrate trouble to be encountered. Each of these factors was investigated, and the theoretical conculsions showed the plan to be workable. Further mention of these findings will appear in succeeding paragraphs.

Approval for construction was given June 3, 1948, and procurement of material and construction of the facilities started immediately. Construction included building a 1600-ft railroad spur, six unloading racks, and two steel buildings and installing three vapor compressors, two liquid transfer pumps, and one 30,000-gal storage tank at the proposed unloading station. A 4-mile 4-in. pipe line, together with a 4800-volt, 3-phase power line and a private telephone line, was built to connect the unloading station with the mixing station. The mixing station was incorporated with the natural gas compressor station injecting gas into the storage wells. A 30,000-gal storage tank, two high-pressure liquid transfer pumps, a steam heat exchanger vaporizer, and one 800-hp Clark two-stage air compressor were installed. One 800-hp Ingersoll Rand single-stage gas compressor located in the main compressor building was converted to a third-stage air compressor. One of the gas compressor station dehydration contact towers was changed to a propane-air-gas mixing tower, and the necessary steam and water connections were made. Air lines, aftercoolers, intercoolers, a carbon and fire arrester, and other auxiliary equipment were installed to complete the mixing plant. This type of material was in short supply, and delivery promises tended to be much later than the conditions would allow. Due to the emergency nature of the program, however, suppliers, contractors, and employes cooperated to the utmost to complete the job on or before the deadline set as July 15, 1948, or a total of six weeks' working time. For a diagrammatic plan of this system see Fig. I.

Mixing

After the plant was completed and had settled into normal operation, six tank cars were unloaded at a time and the liquid pumped to the mixing station through the pipe line with the tank at each end acting as surge tanks and reservoirs to allow flexibility in the unloading operation and the pumping rate. The propane in the storage tanks was used as a supply while the vapor was being removed from the tank cars and while tank cars were being switched to the siding or shuttled along the siding to the unloading points. At the mixing station the propane was then pumped to a steam heat exchanger for vaporization and then to the mixing tower.

During the warm summer operation, the propane was bypassed around the vaporizer as the heat of compression of the air and the natural gas proved the heat for vaporization of the propane. To vaporize 100,000 to 140,000 gal of propane a day from 70 F to 193 F at 540 psia requires from 75,000,000 to 106,000,000 Btu a day. Natural gas in being compressed from an average suction pressure of 200 psig to a discharge pressure of 525 psig gave an actual discharge temperature of approximately 170 F without aftercooling. The specific heat of gas accounts for 24 Btu/Mcf/F temperature change, and thus 40,000,000 to 60,000,000 cu ft of gas in being cooled from 170 F to the injection temperature of 70 F gave 95,000,000 to 144,000,000 Btu per day available from gas compression. The third-stage air in being compressed from 90 to 475 psig had an actual discharge temperature of approximately 375 F and about 35,000,000 Btu per day were available from air compression. When operations began, neither the natural gas nor air was aftercooled before mixing with the propane; however, operation proved that vaporization, by passing this hot gas-air mixture through the propane or the bubble trays in the mixing tower, did not follow the heat balance equations as the gas and air passing up through the liquid propane had a considerable atomizing or mist action. It was found that an inlet temperature of air and natural gas of 90 F regulated by the amount of aftercooling was all that was required to give the 70 F temperature desired for injection into the wells.

Air was supplied by one two-stage Clark Brothers RA8 intercooled compressor taking 6,000,000 cu ft of air per day from atmospheric pressure and delivering the air at 90 psig to an aftercooler and then to one Ingersoll-Rand KVG 800-hp single-stage compressor. The third-stage air was discharged at the same pressure as the discharge pressure of the natural gas going into the storage fields. The air merged with the natural gas just before it entered the mixing tower and then the mixture of natual gas and air bubbled up through the liquid propane. The resultant mixture of propane-air-natural gas leaving the mixing tower entered the field gathering system and passed down through the wells into a sand reservoir lying approximately one-quarter of a mile below the earth's surface.

Properties of Mixture

The general properties of the mixture were as follows: from 100,000 to 140,000 gal of propane were mixed with 40,000,000 to 60,000,000 cu ft

a day of dry natural gas of 0.685 gravity and 1000 Btu and then enough air was added to bring the mixture back to approximately the same Btu content; namely, 1000 Btu. At the higher rates of propane use, 140,000 gal or more, the 1000 Btu standard could not be maintained, as the air compressor capacity was limited to 6,000,000 cu ft a day. The pressure on the mixture varied from 400 to 525 psig in being compressed and stored in the field. The bottom hole or reservoir temperature was 60 F. The vapor pressure of the propane at this temperature was approximately 92 psig. The propane-air varied from approximately 15 to 25 per cent of the total mixture and the propane varied from 6 to 11 per cent. Partial pressures due to the propane varied from 31 to 58 psig and the propane therefore never condensed either in the field lines or in the wells, and no liquid propane has been found in the wells or gathering system dips to date. The averages of spot-check analyses of the natural gas and of the mixture to and from the storage fields are shown in Table 1.

TABLE I (Average of Spot Check Analyses)

	Natural gas, per cent	Mixture to fields, per cent	Mixture from fields, per cent
Nitrogen and non-condensables	11.3	15.3	13.6
Methane	74.7	65.5	72.0
Ethane	13.7	5.8	6.6
Propane	....	10.9	7.0
Butane	....	0.1	0.6
Carbon dioxide	0.1	0.1	0.2
Total	100.0	100.0	100.0

Hydrate Equilibrium

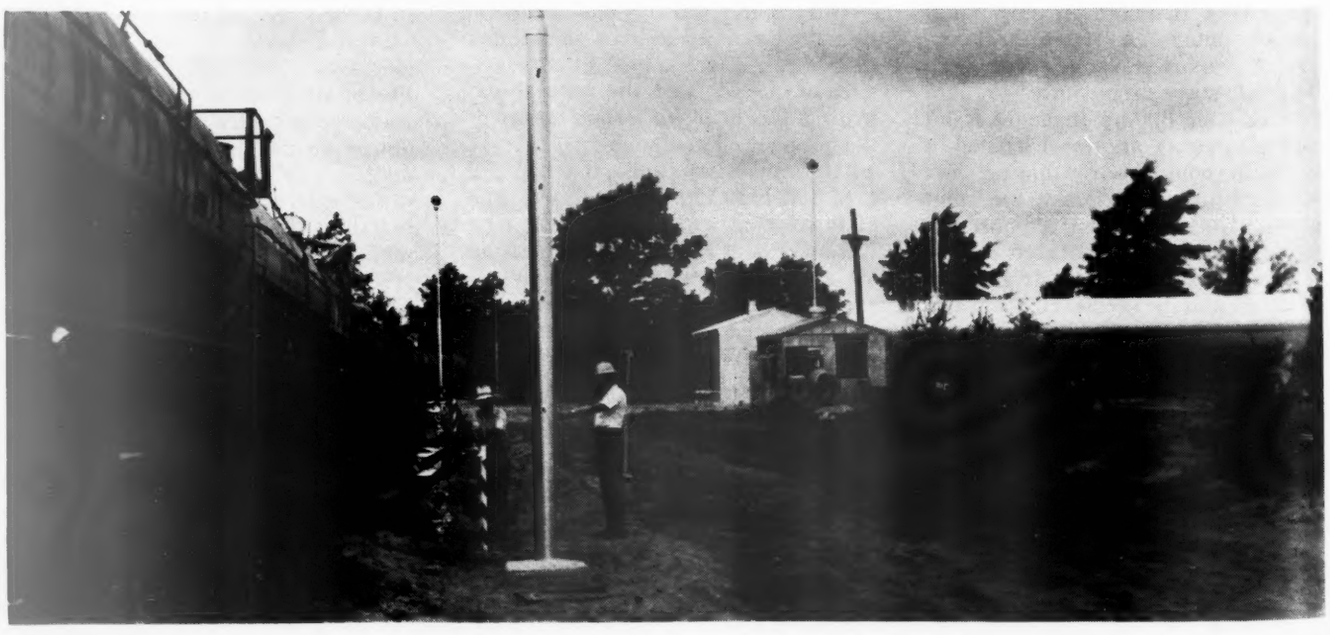
A hydrate equilibrium curve as experienced for the straight natural gas and also for the normal propane-air-natural gas mixture is shown as Fig. 2. For straight natural gas at 540 psia the hydrate equilibrium point is shown on the curve A as approximately 49 F and in normal operation little trouble is encountered except at the wellhead or wellhead drip where there are restrictions with their subsequent cooling effect. An insulated wellhead house and indirect heater counteracts this cooling effect by maintaining a uniform temperature. The hydrate equilibrium point for the normal propane-air-natural gas mixture at 540 psia as shown on Curve B is approximately 56 F. Some hydrate trouble was expected with the storing of the mixture and consequently the wellhead temperature was maintained at or above 70 F. Out of a total of 293 storage wells some hydrate trouble was experienced in 37 wells. Temperature surveys in the wells revealed that a temperature of 49 F was present at a depth between 600 and 700 ft and then rose gradually until it reached 60 to 62 F at approximately 1335 ft. In these 37 wells hydrate bridges formed anywhere between 150 ft and 700 ft below the surface in the well bore and effectively blocked the flow of gas. Neither the use of alcohol bottles nor the shutting in of the well removed the bridge and the only effective method found was to open the well to atmosphere and let it blow the hydrate bridge out. The hydrate bridges occurred more frequently when an insufficient amount of air was added to the mixture to maintain the 1000 Btu heating value. By some experimentation and review of previous operating data, an upper limit of 1030 Btu was set as the maximum allowable point and little hydrate trouble was experienced thereafter. The only control on the Btu range was the amount of air added to the mixture and it was limited to 6,000,000 cu ft a day. Some shipping delays necessitated a greater input of propane than was originally planned and it was at these high input periods that trouble was experienced.

Other Problems

The high input rate of propane occasioned by the shipping and switching delays also created another problem. At times as many as 18 cars a day were unloaded instead of the 12 cars originally planned and the time spent in removing the vapor from the cars became a limiting factor. During the hot weather the propane vapor being pumped from the tank cars would not reliquify fast enough and the tank pressure would rise above 200 psig, thus causing the relief valve to open. It was not possible nor feasible to install a refrigerating unit so a water spray was attached to the tank using the relatively cold ground water and this helped to reliquify the propane to a marked degree. This speed of unloading and vapor trouble necessitated leaving many cars with 40 to 50 psig of propane vapor to go back to the shipper and increased the losses above those normally expected.

When the gathering system was installed in the field, it was not cleaned by the use of a "pig" but was only purged and blown. The high rates of reverse flow and the oxygen content of the propane-air-gas mixture caused old scale to flake off and some new iron oxide to form and then fall off, which was carried to the wells and in

Unloading rack with six unloading stations, one 30,000-gal storage tank, and two pump buildings.



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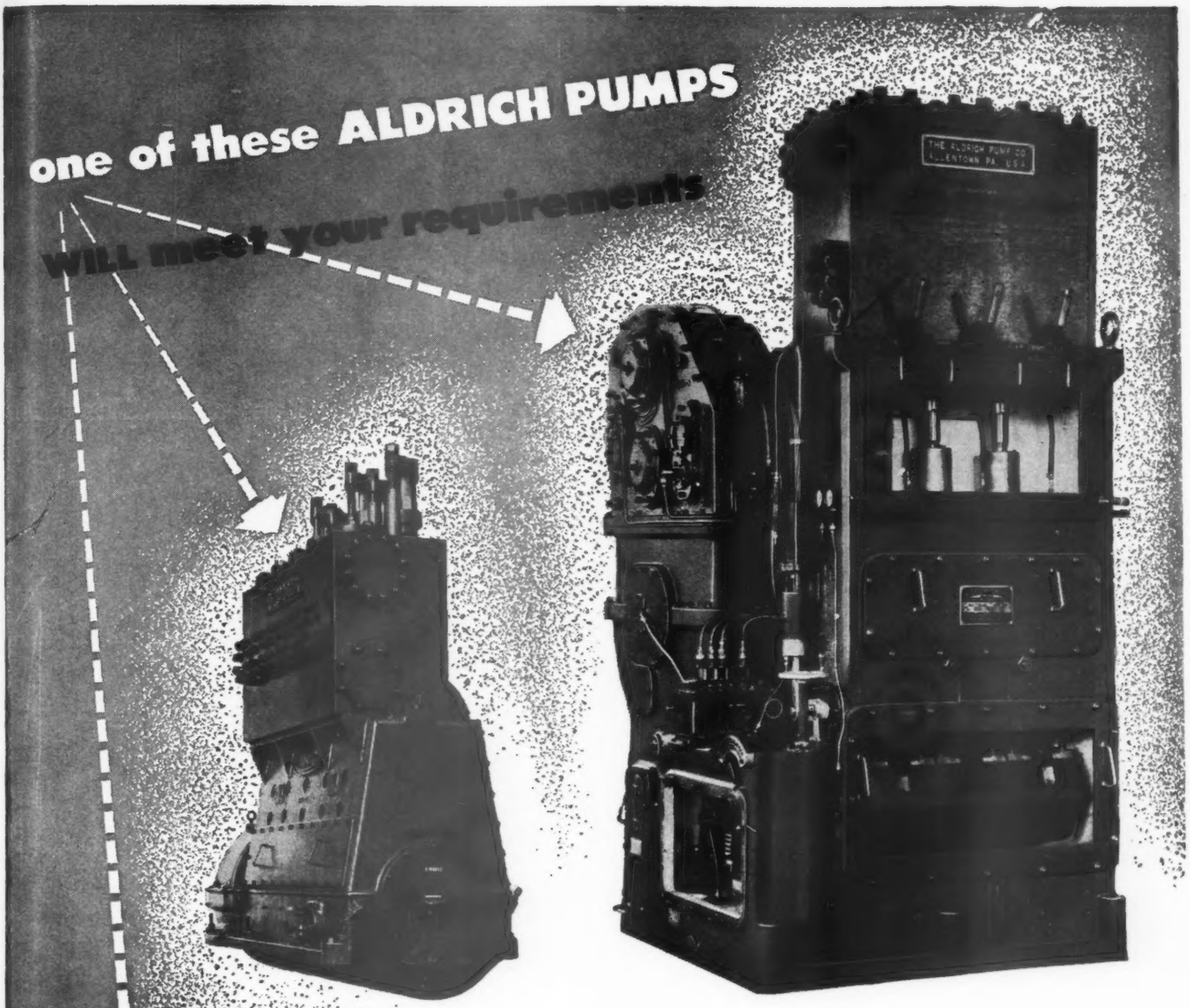

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some instances had to be removed by blowing the wells.

With a compression ratio of 5.2 at times in the Ingersoll-Rand third-stage air compressor temperatures actually reached 375 F or more. Excess oil in the compression cylinders formed particles of red hot carbon on the valves and deposited some oil in the air line. The carbon particles broke off and ignited the oil causing fire inside the air pipe line and raised the temperature of the air going to the mixing tower in excess of 450 F. Careful regulation of lubricating oil did not entirely remove this hazard so an aftercooler was installed and the air cooled to 100 F. A fire dampner and carbon arrester was originally installed just ahead of the air-gas mixing point to keep any fire from the gas and propane. The total oxygen content of the mixture was 5 per cent as a maximum and 17.7 per cent was required to support combustion so no fire in the mixture was possible. The aftercooler installed at this time, together with the intercoolers originally installed, removed a considerable amount of water from the air and helped to reduce the quantity of water in the mixture stored in the field. It also offered another means of temperature control.

To keep the high pressure liquid propane positive displacement pumps from vapor locking in the suction valve ports it was necessary to increase the suction head. A natural gas pressure of 10 to 40 psig in excess of the vapor pressure of propane was imposed upon the mixing station storage tank by means of a differential pressure controller.

Interchangeability of the propane-air-natural gas mixture with straight natural gas was calculated to be allowable at 7 per cent of 1000 Btu propane-air in the mixture as shown in Fig. 3. However, experimental testing indicated a higher allowable per cent mixture and it was believed that little trouble would be experienced with as much as 18 per cent propane-air in actual practice. It developed that approximately 21 per cent of the mixture was propane-air before trouble in utilization developed as experienced by trouble calls from customers.

Volumes Handled

From July 15 to November 1, 1948, a total of 1194 cars containing 11,570,900 gal of propane were handled. Losses due to various causes amounted to 427,520 gal, therefore 11,143,380 gal of propane were vaporized and mixed with 556,380,000 cu ft of air to make 960,000,000 cu ft of propane-air with an average Btu of 1060. This was mixed with 10,660,000,000 cu ft of natural gas to give the resultant propane-air-natural gas mixture a Btu value of approximately 1007 and a specific gravity ranging from 0.720 to 0.790.

From December 13, 1948 to March 13, 1949, a total of 273 cars containing 2,783,920 gal of propane were handled. Losses due to various causes amounted to 16,275 gal, therefore 2,767,645 gal of propane were vaporized and mixed with 210,822,000 cu ft of air to make 310,990,000 cu ft of propane-air gas with an average Btu of 812. This was mixed with the propane-air-natural gas mixture coming from the storage fields, and the resultant mixture transmitted to markets averaged 1000 Btu. These two operations meant that most of the natural gas received from Panhandle during the sumer for storage was enriched twice with propane. During this second period the propane-air percentage of the mixture transmitted to market at times rose as high as 22 per cent at 1000 Btu. At this percentage some trouble was experienced with reducing atmosphere process furnaces raw gas pilots, and a few home refrigerator burners; however, the number of service calls were not great in number and there were very few repeat calls. Higher gavities reduced the input to burners somewhat and in the case of space heating equipment failure to adjust for higher gravity resulted in slightly lower efficiencies. The mixture caused no other disturbances and was utilized all winter.

During the winter some modification in the plant layout was necessary for good operation during the cold weather that, at times, reached minus 20 F. The mixing tower was changed back to a dehydration contact tower to prevent hydrate trouble in the transmission system. The propane was vaporized entirely by the steam heat exchanger and discharged into the suction of the gas compressors. No change was made in the air piping. During this type of operation the vaporization followed the heat balance equations perfectly, and it was necessary to install temporarily an oil field boiler to supply the necessary steam to the heat exchanger.

During the output cycle, the composition of the gas was tested by Podbielniak analysis periodically and no really significant changes between the mixture put in storage and the mixture withdrawn from storage has been noted. The specific gravity of the gas coming from the storage fields has been a good index of the propane-air-natural gas mixture being recovered. It is estimated that by the end of March, 1949, all propane-air gas will be recovered from the fields except for a small amount that has diffused with the cushion gas.

Costs

The total cost of the propane plant except for that material and equipment on hand and available for conversion and use was $252,000. The cost of the 14,354,820 gal of propane including freight to unloading station was $1,576,100. The operating labor, material, and supplies, and fixed charges amounted to $266,900. The total cost of the approximately 1,271,000,000 cu ft of propane-air gas was $1,843,000 or an average cost of $1.45 per M cu ft.

The Michigan Public Service Commission approved the propane project to prevent a gas shortage during the winter 1948-49 and issued an order allowing Consumers Power Company to add a surcharge to the bills of customers for all gas used in excess of 2500 cu ft per month in order to pay for the increased cost of this emergency gas. The surcharge amounted to 14½ cents per M cu ft of gas above the previously stated minimum.

All evidence shows that this project was highly successful and as a result no customer was curtailed in his use of gas beyond the restrictions already in force. This amount of gas together with the milder weather experienced during the past winter enabled the storage fields to go into the 1949 input cycle in a more improved condition

* * *

Predicts Coal-Gas Piped to Southwest

The day when gas made from coal in West Virginia or other coal producing states might be moved in pipe lines to a point in the direction of Texas when the delivered costs of natural gas and coal gas were equal is envisioned.

E. Holley Poe, New York natural gas consultant, said developments for making liquid fuels from natural gas and gas from coal are hastening the day when interfuel competition will cease. He spoke before American Institute of Chemical Engineers, Southwest regional meeting, Tulsa.

Poe predicted that the growth of the natural gas pipe line industry would continue at an accelerated pace for the next few years until the great market areas are adequately served.

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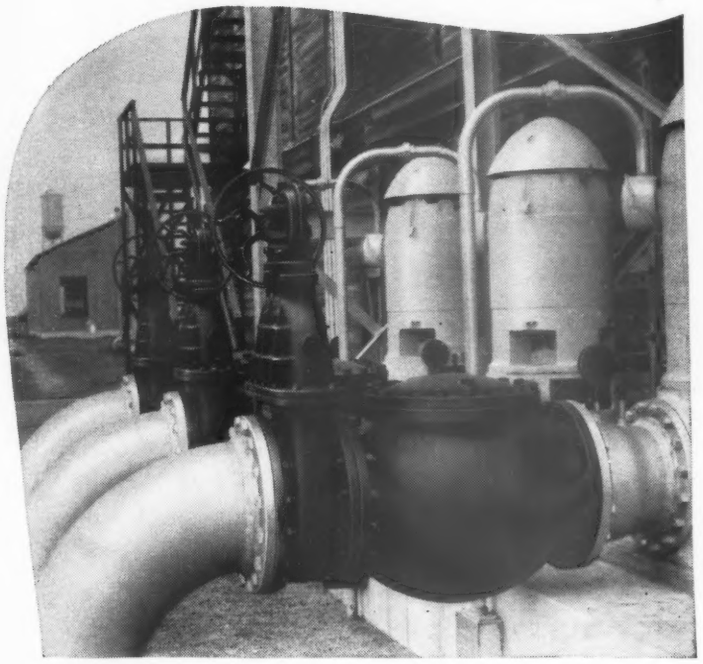

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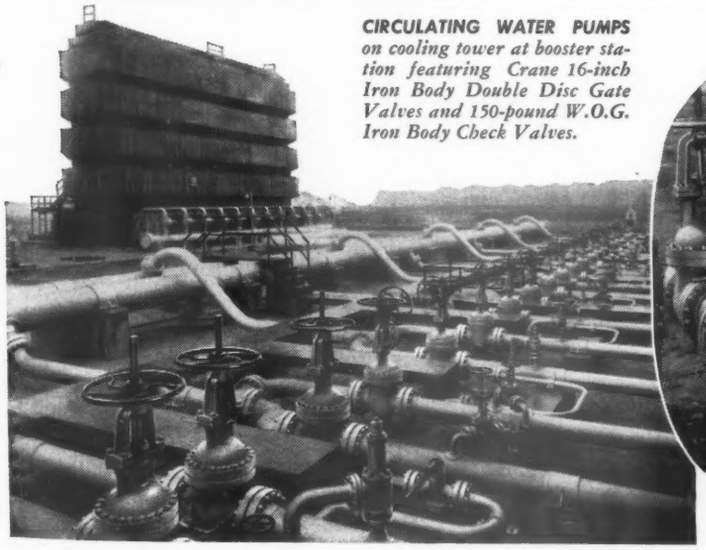
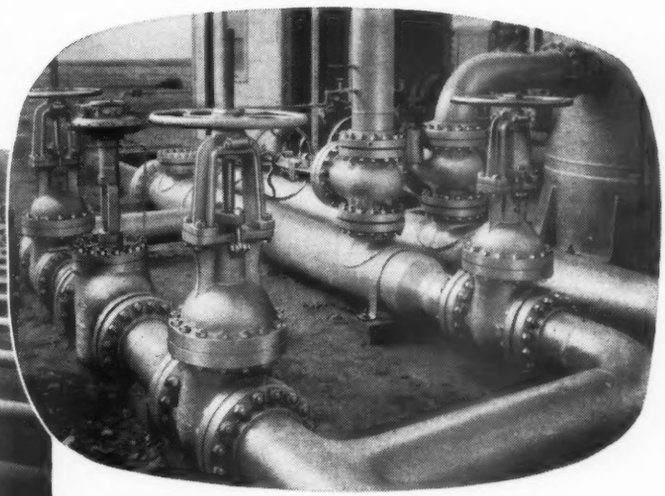


CIRCULATING WATER PUMPS *on cooling tower at booster station featuring Crane 16-inch Iron Body Double Disc Gate Valves and 150-pound W.O.G. Iron Body Check Valves.*



HIGH PRESSURE ABSORBER MANIFOLD *using Crane 10-inch, 300-pound steel wedge gate valves.*

SUCTION AND DISCHARGE *manifold piping to compressor house at natural gas booster station. The broad Crane Line includes all valves, fittings, pipe and accessories for installations of this type.*

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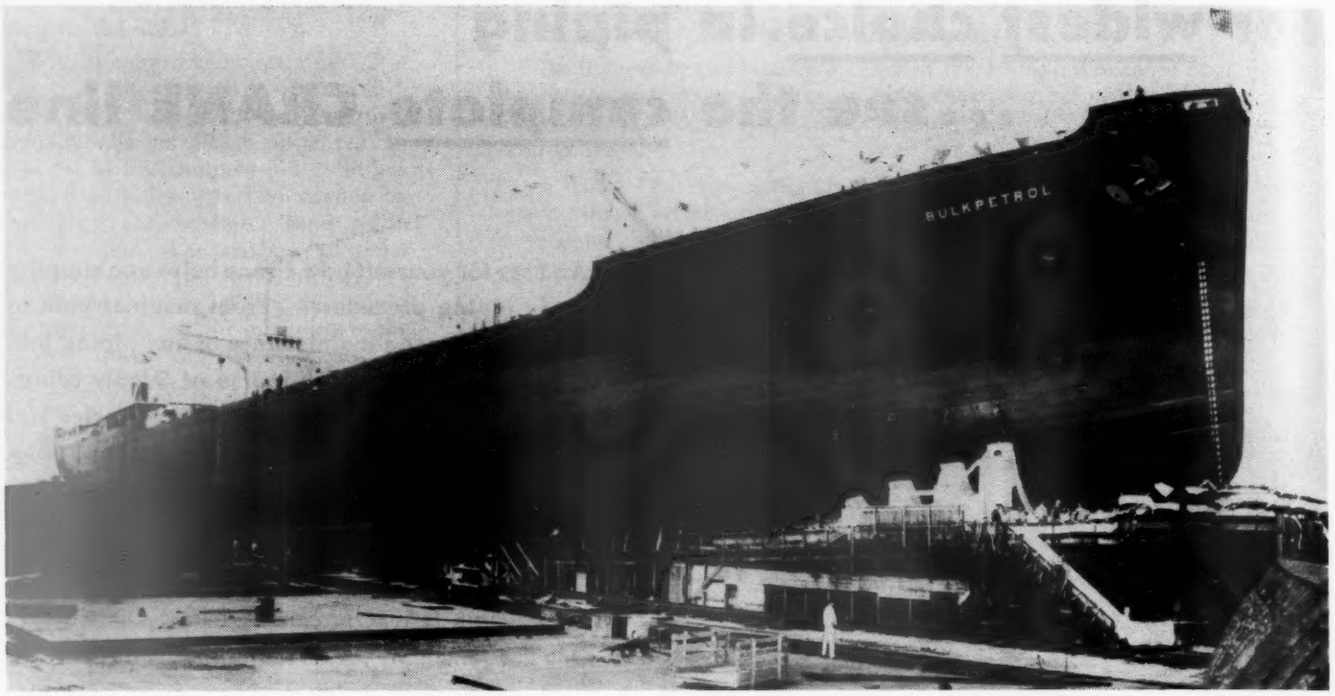

The *Bulkpetrol* on the shipbuilding ways prior to launching. This picture shows tremendous size of vessel as compared with men standing in foreground.

World's Largest Tankers

THE *SS Bulkoil*, sister ship of the *SS Bulkpetrol*, world's largest tanker, was launched at Welding Shipyards, Virginia, recently. These two ships, the largest and most powerful tankers in the world, are examples of the strides made in merchant shipbuilding in this country in the last nine years.

These 30,000-dwt vessels are designed to carry more than 255,000 bbl of oil each, or enough to fill a train of oil cars about nine miles long. General Electric geared turbine propulsion equipment, rated 17,600 shp maximum, give them a loaded speed of about 17.5 knots.

The *Bulkpetrol* was launched in September, 1948, and was delivered to its owners in October, a scant six months after its keel was laid. The *Bulkoil* is expected to go into service soon. Both ships are owned and operated by Oceanic Tankships, S. A., an affiliate of National Bulk Carriers, Inc.

Propulsion power on both ships is provided by steam at 525 psig at 825 F, used in cross-compound turbines. Double-reduction gears deliver power to the single screw.

The cross-compound type of propulsion is essentially a single unit consisting of one high pressure and one low pressure steam turbine. These two turbine elements are connected by cross-over piping to form one integrated unit. Construction of this type permits use of smaller turbines and makes for a more compact installation. Each unit operates at the steam conditions best suited for it.

Steam is taken from the boiler and is expanded through the high pressure turbine, where about half its potential power is used. When the steam has passed through the high pressure unit, it crosses over to the low pressure unit where it is further expanded to utilize the rest of its force. It is discharged from the low pressure turbine into a vacuum where it is condensed into water and returned to the boiler to be used again.

Each element generates approximately half the power of the total unit. Either element may be operated singly in case of emergency. An astern element is incorporated into the low pressure turbine casing.

Double-reduction gears on both vessels are of the articulated type. Each turbine turns a high speed pinion, which is meshed with an intermediate speed gear. Pinions on these intermediate speed gears mesh with a single giant low speed gear, which forms the second reduction step. In this way, thousands of rpm of the turbine are changed to low speed for the propeller.

To speed the handling of cargo and thus reduce overhead by cutting port time, oil is loaded and unloaded by pumps driven by steam turbines. Three G-E 450-hp turbines power the main cargo pumps. Steam turbines are also being used to power forced draft fans. Two G-E 100-hp units are doing this job on each ship.

The *Bulkpetrol* and the *Bulkoil* are another step up in the use of higher steam conditions for more efficient and economical steam propulsion.

* * *

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Approved Practices for Repairing Gas Pipe Lines

By DON ATTAWAY*

EXCLUSIVE

PIPE line repair crews of today are as completely mechanized as an army unit. The mule-skinner of yesterday has been replaced by a "cat-driver." The bulldozers and trucks with their booms, winches, and power take-offs have speeded up and simplified pipe line repair and construction beyond the wildest dreams of the old pick and shovel mucking pioneer. New methods, material, and equipment have replaced much of the human labor and resulted in a speedier, more economical operation.

Despite improvements quite a few serious accidents still occur while maintenance crews are making repairs to gas and oil pipe lines, ofttimes under pressure. These mishaps usually result in an emergency shut-down of the line and sometimes a loss of life or extensive property damage.

In spite of all our training and equipment improvement, the accident frequency in pipelining has begun to rise again. This is due partly to overemphasizing speed and partly due to a lack of knowledge or planned job procedure. The maintenance of pipe lines has always been a fairly hazardous routine. The hazards of the operation result from pressure, corrosion, and material handling. Fires and blowouts are inherent dangers. Even ditch cave-in and gas asphyxiation are possible.

Gas Pipe Lines

The first requisite of repairing a gas pipe line is planning the job with the best degree of skill and judgement and utilizing a trained and skilled crew, equipped in the most complete manner.

When a leak is discovered, the man in charge should investigate to determine how and when the repair is to be made. Usually the district foreman is responsible for this phase. A decision must be reached on whether the repair can be made under reduced pressure or with the line completely shut-down.

Much depends upon the type of leak. It is well to know whether internal or external corrosion is responsible. Sometimes a sand hole or split in the pipe will be found on the bottom of the pipe. Such leaks in or near a seam are more dangerous than elsewhere in the wall of the pipe. If the leak is in or near a sleeve or coupling it is important to know how much pipe is still under the coupling before attempting to do work under pressure.

Uncovering a leaking line must be done with caution. Pipe lines have been known to rupture once the weight of earth cover has been removed.

Having determined the type, extent, and cause of the leak, the foreman should inform and instruct his crew of the procedure to be followed. He should then assemble the proper tools and equipment to make the specified repairs.

Coupling Leak

Let us suppose that the leak is around a coupling and due to faulty or deteriorated gaskets. In Fig. 1 a method of repair is shown that has been successfully used by several major companies. This method permits a repair under pressure and provides a more or less permanent repair. It is highly important that the safety clamps be installed on each side of the coupling before the split sleeve is placed over the coupling.

Once the split sleeve is over the coupling, and pulled up to welding position, a long nipple or vent pipe should be placed in the vent connection and piped sufficient distance away from the bell-hole or ditch. Some crews dilute the atmosphere in the bell-hole or ditch with CO_2 or test it with an instrument for inflammability before starting any electric welding. The vented gas should be permitted to burn in order to prevent it flowing back into the earth cavity.

Once the split sleeve has been

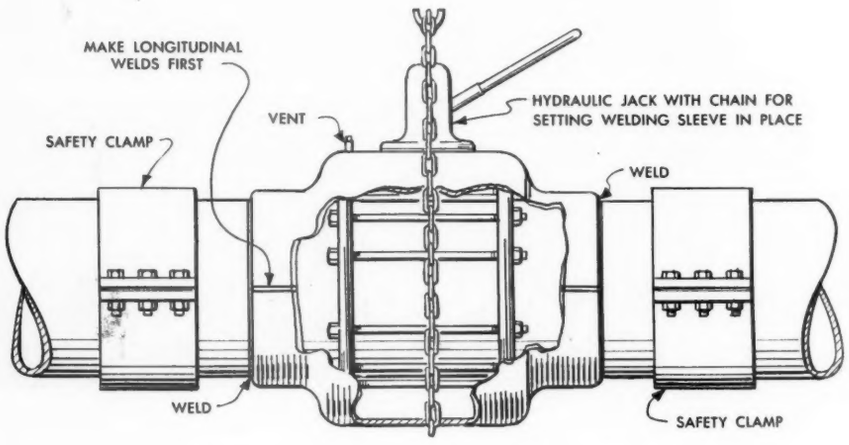


FIG. 1. "Pumpkin" over coupling or long sleeve.

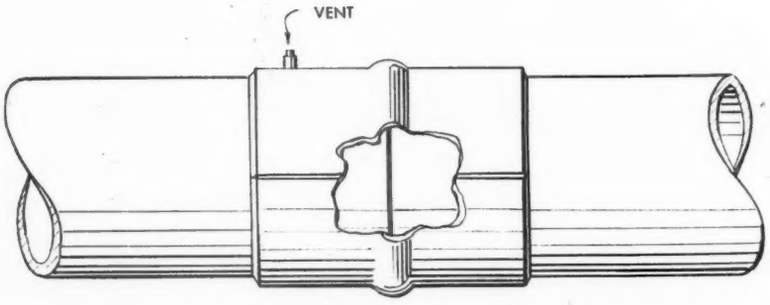


FIG. 2. Split welding sleeve over circumferential weld. (Same installation method as shown in Fig. 1)

*Safety Engineer, Arkansas Fuel Oil Company.

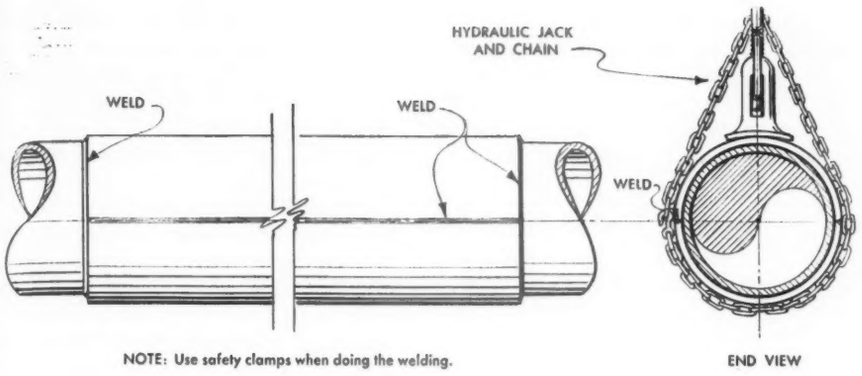


FIG. 3. Pipe of various lengths, split and welded over weak sections of line.

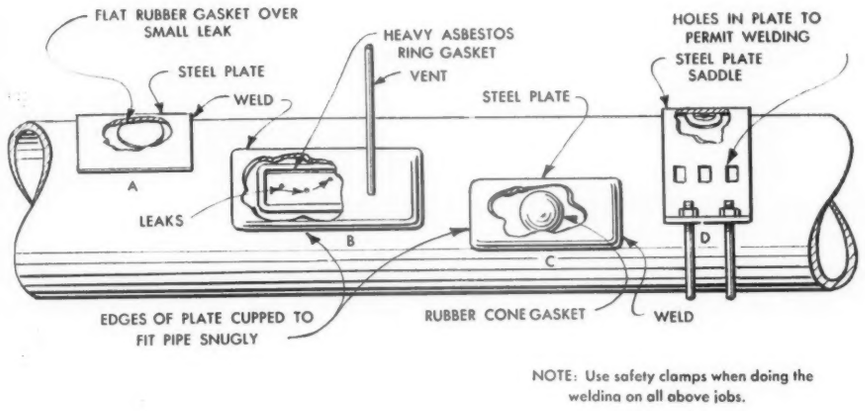


FIG. 4. Welded patches.

welded along all seams, the vent line may be extinguished and removed and the opening plugged, preferably with a bleeder bull-plug.

Welded Joint

In welded lines, leaks often develop in the circumferential welds at joints. (Fig. 2). The same procedure as outlined for a coupling can be used. The extent of the leaks will determine whether or not the line pressure should be reduced. It is desirable in all cases to make some reduction in pressure if at all possible.

Weak Section Repairs

Sometimes certain sections of a pipe line will be found pitted or corroded and it will be found desirable to reinforce this pipe wall. Such a repair prolongs the useful life of the line and prevents a later blowout or leak from developing.

The method outlined in Fig. 3 has been a common routine on such lines. It is well to do this work at a reduced pressure and safety clamps are imperative. Care must be taken in applying the clamps and in binding down the split sleeve as too much pressure on the clamps or sleeve may crush or dent the pipe in a weak section and result in a leak.

Welded Patches

Small pin hole leaks in pipe that is not badly corroded may be repaired under pressure. (Fig. 4). The pipe should be carefully inspected to be sure that a whole joint or section is not weak or pitted. Regardless of how good the external pipe appearance may be, the use of safety clamps is imperative.

The leak "A" in the diagram is a small pin hole and the patch plate is chained down over the leak sufficiently tight to make a positive shut-off. The edges of the steel plate are electric welded. In case more than one pin hole is found close together or in a series, as in leak "B," a cupped plate with a vent plug is more desirable.

The cupped plate as shown in leak "C" makes use of a rubber cone gasket for leaks of irregular shape. Such a patch may be pulled down with a steel saddle plate for welding.

Side-Tap Leaks

Quite often the nipple in a hot or side-tap on a pipe line will develop a leak in or around the weld. These leaks have been difficult to repair without a complete shut-down. The method pictured in Fig. 5 has been used numerous times and with complete success and safety.

The extent of the leak determines whether pressure should be reduced, but if possible a reduction is desirable.

The split bull-plug must make a metal-to-metal fit and can be pulled into position with a jack and chain. The vent opening must be piped away before any welding is begun. Once the weld is made the vent may be plugged and the repair checked for leaks. It is desirable to plug all vents with a bleeder bullplug so that their removal may be done safely, in case it is necessary to reinstall the vent line to do further welding of leaks.

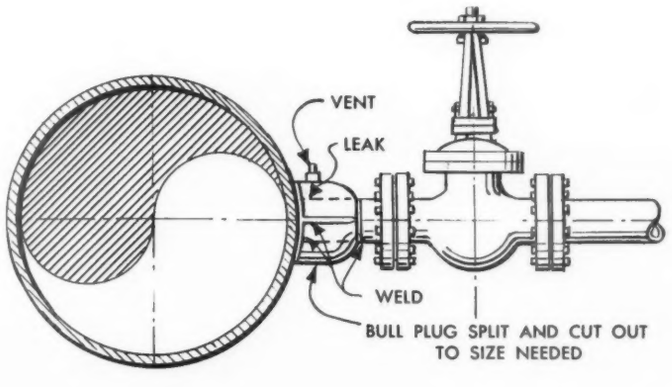
General Precautions—Fire

It is important to have all men who work in or around leak repairs or escaping gas to remove all matches, or cigarette lighters from their clothing and leave them on the truck before going to the job.

Heavy woolen clothing appears to hold gas vapors more readily than cotton garments and are capable of generating a static spark.

When welding is being done, a dry chemical fire extinguisher should be on hand and one man detailed to stand by for quick use. Either powder or

FIG. 5. Repair to leaking side tap.



carbon dioxide may be safely turned on a man who is on fire.

No welding should be done until escaping gas from the vent is at a safe distance and the bell-hole or ditch tested for inflammable vapors.

Cars and trucks needed in the area of repairs should be parked some distance away and on the upwind side if possible.

Blow-Out or Explosion

When a high pressure line explodes, it has much the results of a boiler failure. Care and judgment must be exercised to the highest degree.

While making repairs, the pipe line should not be shocked or jarred. Extra vibration may enlarge the leak. If any doubt exists as to whether the repair can be made safely under pressure the line should be shut down.

Care must be taken in uncovering the line and if old clamps are present on the line, they should *not* be removed. As an extra precaution, new and substantial clamps can be placed on each side of old clamps. Split sleeves or patch plates should never be removed from a line under pressure.

Personal Protection

In cases where lines are deeper than 4 ft, the trench should be shored if the soil is loose to prevent cave-in.

There is also an exposure to the eyes where rust, dirt, or dust is present and goggles should be worn while making these repairs. In some cases where the ditch or bell-hole is deep and much gas is present a fresh air hose mask is desirable in order to be able to work in an oxygen deficient atmosphere.

Conclusion

Invention and engineering may make future improvement upon devices and methods for maintaining pipe lines but the safety of such operations depends upon the care and skill of workmen and supervisors, for usually new machines create new hazards and new methods demand new knowledge.

Since 1942, the accidents per million manhours worked in pipe line operations have risen from 9.46 to almost 15.00 in 1947. This trend is a clear indication that more safety information must be developed and these safe practices given to the workers themselves. The reduction of accidents depends upon the attitude of supervisors and workers as well as their knowledge of the equipment and its operation.

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2. "Making Repairs to Loaded Pipe Lines" by W. T. Pyott, *The Petroleum Engineer*, April, 1943.

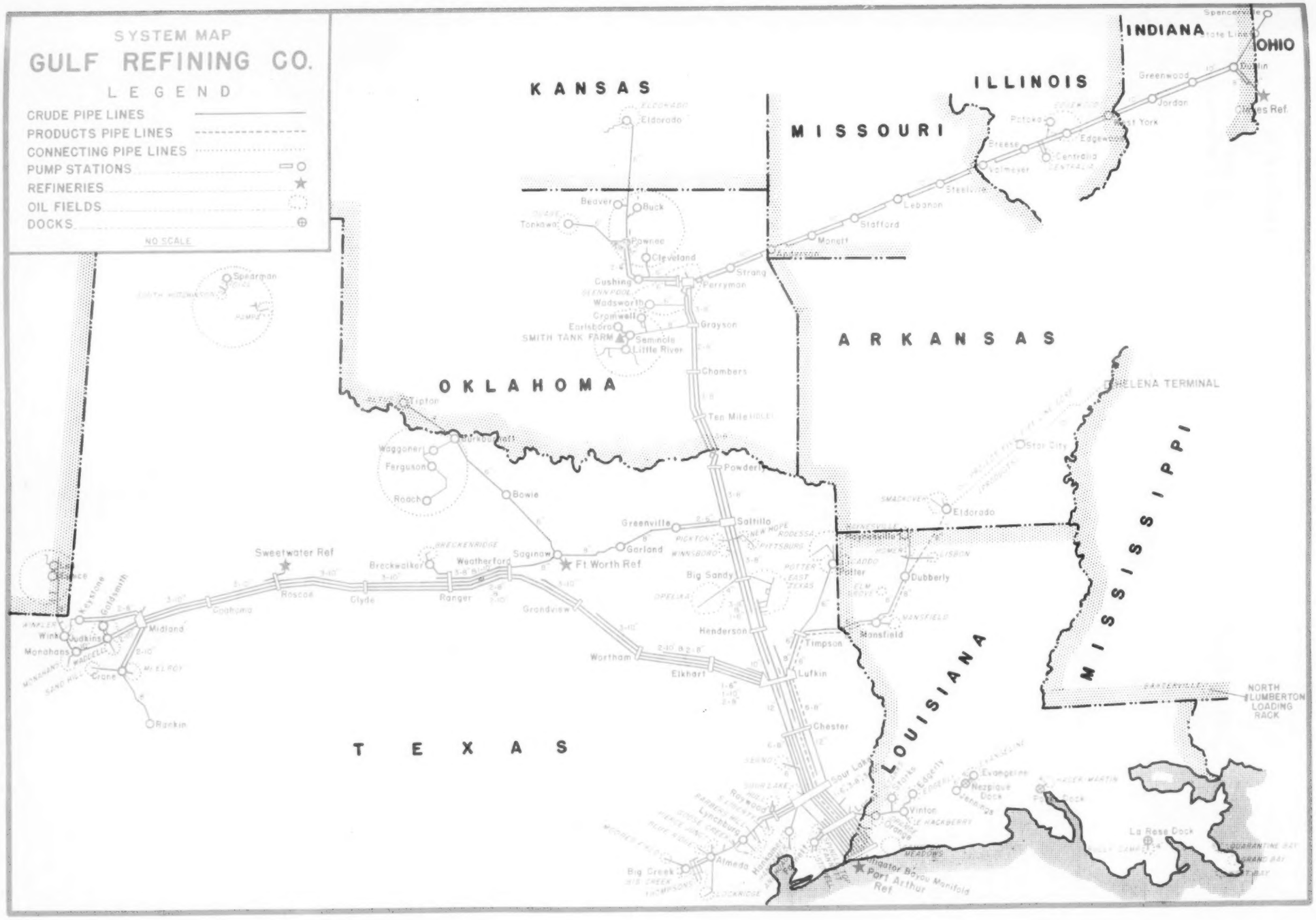
* * *

Argentine's 1100-Mile Gas Line Makes Progress

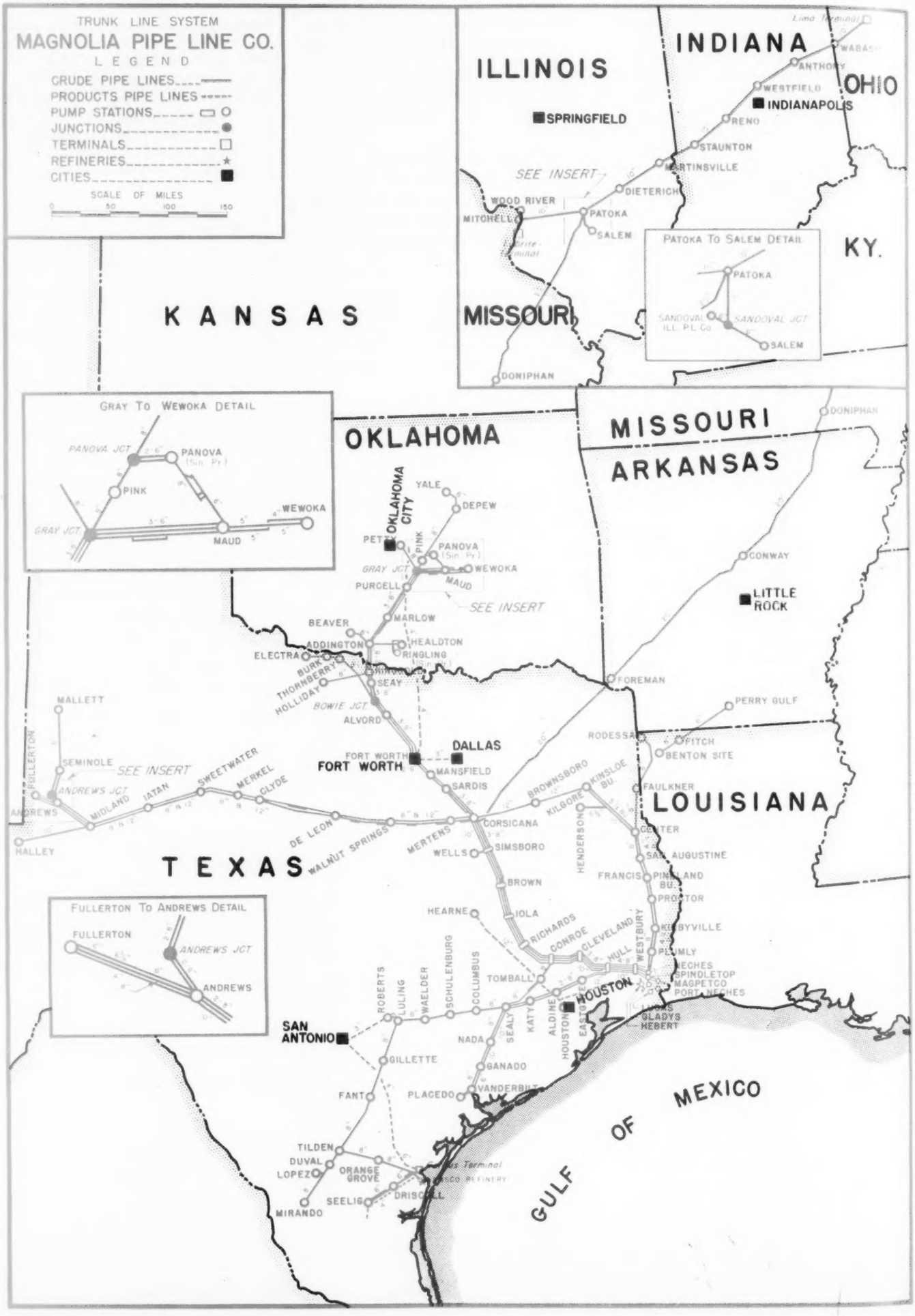
The 59.6-mile section comprising the area between San Antonio Oeste and General Conesa of the Argentine 1100-mile natural gas pipe line from Comodoro Rivadavia to Buenos Aires has just been completed. This was one of the most difficult sections, as the pipe was laid across the Río Negro, whose bed is 985 ft wide at its crossing point. Difficulties were also encountered with the extremely rock terrain and inclement weather.

The most modern equipment was utilized in this operation. Work was carried on an average of 1.8 miles per day, with 382 men working on the job. In order to speed up the construction work on the 10¾-in. 1100-mile pipe line the job was divided into two spreads: the North Section comprising the area Buenos Aires-General Conesa built by the Argentine Government through its department Direccion General del Gas de Estado, and the South Section covering the area General Conesa-Comodoro Rivadavia is under the construction of the contractor, Compañia Tecnica Internacional. With the completion of the Section San Antonio Oeste-General Conesa, it is expected that the Comodoro Rivadavia-Buenos Aires pipe line, South America's longest pipe line and one of the world's largest, whose work began in the earlier part of 1947, will be finished shortly.

Coating and wrapping equipment in operation on Argentine Government's 1100-mile gas line between Buenos Aires and Comodoro Rivadavia field.



From *The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.*



From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.

Engineering and Economics of Pipe Lines*

JOE L. CAHILL†

WHEN the modern petroleum industry was born with the drilling of the Drake well in Titusville, Pennsylvania, in 1859 the problem of transportation arose. The first movements were by water, and wooden tubs were fastened to flatboats or barges and floated to their destinations. This method was slow and, even for those times, expensive. Later the same type of tub was mounted on railway flat cars and the economics of transportation became a science in the oil fields.

Barge transportation was undependable and unsafe and fully 30 per cent of the cargoes were lost either from collision, fire, or upsetting in the swift waters of the Pennsylvania rivers leading to the markets at Pittsburgh. Rail transportation at that time, although safer than the riverboats, was still slow and unreliable. It was inevitable that one of those shrewd petroleum pioneers should think of pumping oil through a pipe from well to refinery stills.

In 1865 the first pipe line, 4 miles long, was laid in western Pennsylvania. In 1875, a 60-mile, 4-in. line was laid from Western Pennsylvania to Pittsburgh. There is little information on the development of these early lines but the records show that in 1879 there were more than 700 miles of trunk and gathering lines in existence. In 1880 this mileage had nearly doubled. In 1890 the total mileage was 5390, an increase of nearly 450 per cent. From this small beginning came the great sprawling interlocking network of crude and products pipe lines we know today.

In 1923 there were 64,760 miles of pipe lines of which 51.2 per cent or about 33,000 miles were trunk lines.

Statistics

Although at the present time I do not want to bring in a lot of statistics that in themselves are meaningless and probably will not be remembered anyhow, the economics of pipe line operation are dependent so much upon various governmental restrictions that some statistics will be necessary in order to make clear the present predicament of the pipe lines, and to demonstrate the growth of the pipe line in the economic development of the oil industry as a whole. These statistics have been gathered from *Petroleum Facts and Figures* issued by the Bureau of Information of the American Petroleum Institute and from statistics of oil pipe line companies reporting to the Interstate Commerce Commission, prepared by the Interstate Commerce Commission. Up to 1945 we have been able to obtain from the API figures representing all pipe line companies, both intrastate and interstate, but since that time only those reporting to the Interstate Commerce Commission have been available. Pipe lines engaged in interstate commerce are common carriers and are therefore required to report all their operating figures to the Interstate Commerce Commission quarterly. Those pipe lines that are operating entirely within a state are not under the jurisdiction of the Interstate Commerce Commission and are therefore not obliged to report their income or any operating statistics. This gives rise to the discrepancy between the 1945 total pipe line mileage and the 1947 figure, which you will undoubtedly notice when the comparisons are quoted.

The first record of products line mileage appears in 1928 when the Bureau of Mines listed 250 miles of products trunk lines. This undoubtedly represents for the most part converted crude lines. In 1940 this figure had risen to 9000 miles, whereas the total for crude lines rose to 116,900 miles of which 62,400 miles or about 53½ per cent were trunk lines.

Speaking financially for a moment, these figures represent the pipe line mileage of 66 pipe line companies with a combined investment in carrier property (ICC valuation) of $841,976,902 and a total throughput during this year, both products and crude oil, of 958,302,690 bbl. In 1942, the first war year, there were 69 pipe line companies involved in interstate transportation of petroleum and petroleum products whose ICC valuation amounted to $918,847,714 and who transported 1,073,800,382 bbl of crude oil and products. In 1945, the total investment in pipe line transportation properties amounted to $1,042,522,828, whereas total pipe line revenues from all sources were $304,268,132, representing 2,379,243,526 bbl of crude oil and petroleum products delivered through 141,887 miles of trunk line and gathering systems. In this year there were 67,003,259 ton miles of petroleum and products moved by rail compared with 89,196,000 by pipe line (trunk line only).

In 1947 there were 119,298 miles of pipe line belonging to 71 companies reporting to the ICC, an increase of 5947 miles over 1945. There are available, however, no figures for the mileage of intrastate lines not reporting to the ICC beyond 1945. This increase represents 1915 additional miles of gathering system, 2047 miles of products lines, and 1985 miles of crude oil trunk line, and a total valuation at December 31, 1947, of $1,225,168,434, an increase over 1945 of $18,264,606. The operating revenue of these 71 companies amounted to $325,223,884, of which $53,144,549 was net income, a return of 4.34 per cent on investment. During this year a total of 2,474,339,745 bbl was transported over these 71 systems.

The above figures indicate that pipelining is a sizable business. In 1906 the Hepburn Act proclaimed the pipe lines to be common carriers and thereby subject to federal regulation. This was but the first step in restrictive regulations intended to place pipe lines on a competitive basis with other common carriers. The so-called "Consent Decree," made effective January 1, 1942, and which limited the distribution of earnings to the shipper owners of the pipe line company to 7 per cent of its ICC valuation was the

*Delivered before Mid-Continent Section, American Society of Mechanical Engineers, Tulsa, Oklahoma, February 24, 1949.

†Chief Engineer, Pipe Line Department, Continental Oil Company, Ponca City, Oklahoma.

final stroke. More about this later; however, before we progress too far I would like to return a moment to the 1945 ton mile and revenue statements to illustrate further the penalties for economical and efficient transportation placed against the pipe lines.

For moving 67,003,259 ton-miles of petroleum products the railroads received $480,435,063, or $7.17 per ton-mile, whereas the pipe lines received $294,708,924 for moving 89,196,000 ton miles, or $3.30 per ton mile. Further, the revenue derived by the railroads for the transportation of petroleum products declined from 10.90 per cent of total revenue in 1931 to 6.01 per cent in 1941. In 1943 it jumped to 9.79 per cent, a 10-year high, but this is understandable due to wartime conditions. In 1945 when postwar pipe line expansion was just getting under way it fell to 7.32 per cent, reflecting, no doubt, the decrease in military demands.

Economics Defined

Before we discuss the Consent Decree and its application to pipe line economics I would like to digress a little and define economics from my viewpoint. Economics to me means the science of man's making a living and contains the historical development of economic laws and theories as well as the methods and tools given to man with which to make this living.

We were formerly taught that there were five factors in production: Land, labor, capital, management, and government, and that each was entitled to its own particular share in the proceeds of production. We were taught further that if the system came into unbalance and that anyone of the factors received more than its share then there would be an eventual leveling out and the system would again be brought into balance. Land might raise its rent, capital its interest, management its profits, labor its wages, and government its taxes. Or the reverse might be true and the whole was governed by the laws of supply and demand. Increased governmental regulations and the decreasing spread between gross income and operating profit has given rise on the part of management to technological research. The natural sequence to this has been more efficient machinery, the increased use of automatic controls, and the gradual decrease in manpower per unit of production. This applies not only to pipe lines but to all productive enterprises.

It is peculiar to the pipe line industry that certain phases of it, particularly trunk line station operation, lends itself remarkably well to automatic controls and more efficient pumping machinery. Some of the pipe lines are unionized and the union requirements in some localities are such that for each unit in a station a certain number of men must be maintained. It is a short logical step from these and other increased costs to the result that a 300-hp engine can be run with one-half the crew of two 150-hp units and pump the same amount of oil. Up until the last ten years or so the old slow speed internal-combustion engine and reciprocating pump, since they were fully depreciated, were making money and pumping oil cheaper than the newer high speed units, however, as the operating cost increased the economics dictated that larger, more efficient units be installed, and that the spread between the operating costs and gross income be increased.

The Consent Decree had a great deal to do with the transition and the abandonment of the fallacy that a pipe line was a common carrier entitled to a just profit. As we saw previously, in 1947, the return on an investment of over a billion dollars was only 4.34 per cent under the new economic laws. That 4.34 per cent was management's share in the proceeds of production. In the same year all operating expenses amounted to 17.52 per cent. Taxes amounted to 4.58 per cent and labor's share mounted to 8.25 per cent of total valuation.

The Consent Decree

No consideration of pipe line economics can be complete without at least a partial study or explanation of the "Final Judgment," popularly known as the "Consent Decree," and while I do not feel qualified to explain the Consent Decree I shall do my best to set out its provisions and explain what little I know of its application. The Consent Decree is that decree entered by the United States District Court for the District of Columbia on December 23, 1941, in the case of the U.S.A. vs the Atlantic Refining Company and others, Civil Action No. 14060. In this action the United States sought an injunction against the several defendants and a forfeiture of three times the amount of alleged refunds, rebates, and effects paid to the shipper owners by the defendant common carriers after January 1, 1935.

This action was brought under the terms of the Elkins Act and in it the government attempted to have the court hold that the payment of dividends to shipper owners constitutes a rebate in violation of the terms of the Act. Paragraph III of the decree prohibits defendent common carriers from crediting, giving, granting, or paying, directly or indirectly "through or by any means or device whatsoever, to any shipper owner in any calendar year commencing as of January 1, 1942, any earnings, dividends, sums of money or other valuable considerations derived from transportation or other common carrier services which in the aggregate is in excess of its share of 7 per cent (7%) of the valuation of such common carrier's property, if such comon carrier shall have transported during said calendar year any crude oil or gasoline or other petroleum products for said shipper owner. . . ."

Paragraph V of the Act reads as follows: "Commencing January 1, 1942, each defendant common carrier shall retain (except as hereinafter provided) net earnings derived from transportation or other common carrier services in excess of the amounts permitted to be credited, granted, paid or given by Paragraph III hereof, and transfer such excess earnings to the surplus account within 90 days after the end of each calendar year. The said excess earnings shall be transferred to the surplus account as a separate item therein and in such a form as to be readily identifiable."

This excess earnings transferred to surplus account may be used for the acquisition of carrier properties and the income from such properties is in turn restricted and not available for distribution to stockholders. Debts of the defendant carriers to their parent company for construction of carrier facilities in existence prior to January 1, 1942, may be paid from the segregated surplus.

The initial "final" valuation in this judgment refers to the valuation as of December 31, 1934, made by the ICC. Under the terms of the Consent Decree it is this valuation plus adjustments to date that is used by most of the pipe line carriers in determining the distributable earnings to shipper owners. I believe at this time two of the pipe line carriers covered by this decree have been working under adjusted valuations based on December 31, 1939, and new valuations as of 1947 or 1948 are projected. The method of determining new final valuations is one that has been argued long and loudly by the legal and accounting departments and until they arrive at some conclusion it cannot be a concern of engineers.

For the record I would not attempt to expertize the application of the Elkins Act and decree to the pipe line companies; however, from my personal experience I know that there is so much interchange of oil between shipper owners and so many parallel pipe lines in existence today that com-

petition itself would tend to keep the rates reasonable. The increased trend of government to regulate instead of govern will probably reflect an effort to augment the control of the activities of pipe line companies and their owners. You have only to read the newspapers the past few weeks and see the attempt on the part of one senator from a northern state to divorce not only pipe lines but barge lines from the oil companies that own their stock and supply a large volume of the product moved over their systems. I bring in these political aspects and their effect on pipe lines operations because they have a very great bearing on pipe line engineering and economic problems and will, no doubt, have a very strong bearing on the future engineering and economic treatment of all industry.

In terms of economics you can see what this means. By limiting distribution of earnings to 7 per cent there is a restriction on incentive to accumulate funds from earnings for replacement of obsolete and worn out equipment. There can be no funds available from unrestricted earnings for the purchase of improved machinery when the old becomes technologically obsolete. The normal depreciation rate based on purchase price in effect 20 or even 10 years ago leaves little when you consider today's relatively high prices. Consequently the pipe line engineer finds himself doing one of two things, either he patches his old lines and squeezes the last drops through between the leak clamps or he borrows capital.

Technical Advancements

These facts plus the increased demand for petroleum products coupled with the shortage of pipe has hastened the technical advancement in the science of pipelining. Many of the major pipe line companies have doubled and tripled their engineering staffs in the last five years, and finding that the average engineer was unfamiliar with the operating methods of a pipe line, many have begun training programs to familiarize junior engineers with the basic practices of pipelining.

The Continental Pipe Line Company has two of these training courses in effect right now, one for technical personnel and one for clerical. Engineering graduates are taken from the campus and presented with a pipe wrench and for six months work in the gang as a connection man. After this assignment they spend two months as a district gauger, one month each as station engineer marine terminal helper, and district clerk. After this they spend six months working directly under the chief engineer preparing surveys, maps, cost estimates, station and piping designs, etc. They are then ready to take their place as a district engineer.

New Equipment

One of the most important developments to ensue from previously mentioned conditions is new equipment. It is interesting to travel from station to station on almost any large pipe line and see the historical development of the pumping unit. On one western line with which I am familiar can be found an old single-cylinder horizontal oil engine with a fly-wheel 15 ft in diam driving an old duplex pump. This unit was originally installed in 1912 and moved to its present location in 1928 and will probably run there for 10 more years. At the next station down the line is a modern turbo-charged dual-fuel engine driving the latest thing in pipe line pumps, a 10-cylinder reciprocating job putting out 30,000 bbl per day at 1000 psi. This unit occupies about one-third the space of the old single-cylinder pump unit and puts out three times the oil—that's pipe line progress. It hasn't all been easy though—these new high speed units have developed problems all their own. When first installed the vibration was so intense the header welds crystallized and broke away. One pipe line company experimented for two years before getting its units to work satisfactorily, another company is still trying to work its out. But we're making progress. The transition from 85 rpm to 400 rpm has certainly destroyed our previous concept of how fluid travels in a pipe.

Engineering

It is reasonably safe to say that the entire field of pipe line engineering has changed in the last 10 years. Gradually line sizes have become larger, reflecting increased applications of true hydraulic principles and the work of far-seeing pipe line engineers who have advanced science as a whole through their studies of fluid flow. Here economics has played its part by combining with hydraulics in the determination of optimum pipe sizes. Many factors influence these selections: The potential of the field, area service, probable life of the field, payout, and of course always the immediate needs of the refineries for crude. We in our time have seen the average line size grow from 4 in. to 12 in. with 31 in. the largest crude oil line being laid at present. Gathering systems that used to be 2 in. are now 4 and 6 in. with 8 and 12 in. not uncommon. The pipe shortage has had a great deal of influence on pipe sizes in the last three years resulting in many looped lines, which for good engineering practice should have been rebuilt in larger sizes.

Perhaps the greatest change, however, has been in engines and pumps. Some lines, particularly products lines, have gone to electric motors entirely for prime movers. As a pipe line engineer, the economics of electric motors for pipe line services has never been justifiable to me except in isolated instances because power and demand charges soon eat up the first saving in prime mover cost. Many pipe lines, however, are now going to electric motors and centrifugal pumps to decrease the amount of capital necessary to install new facilities, believing that the increased operating cost can more readily be borne as new requirements for capital loans to pipe lines now require that companies' indebtedness be repaid before there is any distribution of earnings even up to the 7 per cent allowed by the Consent Decree. This, however, is a debatable subject and there are probably enough single cases to prohibit any general rules. Besides there are probably too many power company engineers in this group for me to talk down all by myself. My point is merely that only a few years ago electric motors were almost unheard of for trunk pipe lines.

Now the diesel and gas diesel men have come along and have offered us engines with high efficiency to run on the crude from our lines and from the field gas usually available at low costs wherever pipe lines run. Engines with efficiencies of up to 40 per cent are now on the market at costs, even in the present era of high prices, less than the old heavy gun barrel types. There is even a full diesel on the market now suitable for direct connection to centrifugal pumps without the use of separate step-up gears. Interesting also is the large increase in portable, high capacity skid-mounted units. This is a natural sequel to the looped lines and the temporary hookups used everywhere to satisfy the unprecedented demand for crude and products despite the pipe shortage.

It is well within the memory of most of us here when the slow speed reciprocating pump turning from 30 to 80 spm, was the last word in pumping equipment. These were usually belted to a big steam engine or to one of the old heavy slow speed gas or diesel engines. The centrifugal pump was the next step in the overall improvement of pipe line pumping equipment and they were usually connected through either belt drives or step-up gears to obtain the necessary speeds.

The centrifugal pump for some applications was a tremendous improvement over the reciprocating type, particularly for trunk line operation where the volumes and pressures were relatively constant. Their greatest disadvantage was the lack of flexibility and they were never completely accepted in the pipe line industry. The development of rural power brought in the electric motor as a prime mover and increased the utilization of centrifugal pumps because they could then be direct connected without belts or gears. This, too, had its disadvantages, lacking the same flexibility of the internal-combustion driven centrifugal pump and also its adaptability to a staggering operation.

Reciprocating Pumps

The next step was the development of the multi-cylinder reciprocating pump, which was adapted for high speeds and direct connection to medium speed prime movers. These pumps started with 3-cylinder and went up to 9-cylinder, and with smaller plungers eliminated a great deal of the inherent mechanical difficulties of the old plunger pump and gave greater operating flexibility than centrifugals. They were, nevertheless, still subject to pressure surges and vibration, however, their place in the historical development is well marked. To obtain further flexibility and adaptability, and to permit the greater use of automatic controls in pipe line pumping stations, the variable stroke pump was developed. This pump was designed to deliver varying quantities of fluid at constant pressures and constant speeds. This lent itself to operation by constant speed prime movers and to remote control, which again tended to reduce the operating cost of pipe trunk lines operations.

The next thing in the pumping equipment field was the multi-cylinder single-acting pump having a very short stroke, which is a further attempt on the part of the pump builders to combine the smooth operation of the centrifugal unit with the flexibility and high efficiency of the piston pump. There is no doubt in my mind that there will be a continuing effort on the part of equipment builders toward manufacturing pumping units with higher efficiency, greater flexibility, and increased use of automatic controls to eliminate insofar as possible the human element in station operations and the demand for this type of unit will keep increasing as the effort to maintain the balance between increased labor costs and lower gross profits becomes more noticeable.

Since World War II we have seen a new concept in engines as well as pumps. Diesel power is gradually replacing gas in pipe line operation. Although it will never completely replace gas in all operations the price of gas as a fuel has climbed from a low of 0.05 cent per M cu ft to as much as 0.40 cent per M cu ft in some places where pipe lines operate. This is normal and perhaps the pipe lines themselves are to blame for this increased cost, for they have widened the distribution area of gas produced in the southwestern states to include practically the whole country, and the law of supply and demand has backfired on the pipeliners to the extent that what was once thought a cheap and plentiful fuel is getting scarcer and more expensive day by day.

The increased use of diesel fuel and the smaller diesel cuts that are being taken from the crude oil due to increased refining efficiency and the striving for higher gasoline yields has driven the price of diesel fuel to a point where it is uneconomical to use. So long as an oil pipe line pumps oil, however, it has at its command a very cheap source of fuel—crude oil. Although crude oil can be used for fuel in most low speed diesel engines merely by applying proper filtering practices, the medium and high speed diesels, which are coming into greater use for pipe line pumping, require narrower limits for their fuel than can be obtained from most crudes. It has proved profitable in some cases to use portable treating plants, which have recently been developed to use the waste heat from the engine exhaust to practically refine the crude oil into usable diesel fuel.

Portable Units

The peculiar circumstances that have arisen due to increased crude oil and products demands and the pipe shortage have increased the demand for portable booster units and have made it profitable even to use high priced diesel fuel to save the expense of building a permanent station that would have to be dismantled when pipe becomes more plentiful and lines of adequate sizes can be laid. This has had one advantage in that it has shown pipe line operators that the modern high speed diesel is as reliable and more economical than the old heavy slow speed unit.

Perhaps the greatest job the engine builders have had to do in the last ten years is to convince the pipe line operators that the high speed pumping unit is here to stay and to convince them that the old heavy pig iron is no longer necessary for long-lived efficient operation.

I have purposely left the discussion of the gas diesel to the last, as it is the latest development in the pumping picture. There is no doubt that economic circumstances and increased research have raised engine efficiency to the point where any prime mover delivering less than 40 per cent thermal efficiency will be out of the pipe line business before too long. Like all new things, however, there are still bugs to be worked out of the gas diesel. Although increasing fuel costs will encourage the pipe line operators to aid the dual-fuel engine builders in their research, the development of the super-charger will also play an important part in the full utilization of the gas diesel. There have been a few accidents with the supercharged gas diesel engines, however, too much importance should not be attached to these and I believe that they will have served their purpose by teaching the engine builders what not to do with this type of engine.

Taken by and large it is difficult to say that any one single factor is responsible for the increased employment of engineers in the pipe line industry. The need for more efficient operation caused by higher operating costs and lower allowable returns, the increased demand for petroleum products, and the pipe shortage, all three perhaps account for most of the changed thinking in pipe line economics but the increased importance of the engineer and the greater dependence of management on engineering guidance throughout the petroleum industry as a whole is probably now being reflected in pipe line management policies.

You will note that very little has been said about gas pipe lines. These are a field unto themselves and would require special treatment. Although some of their basic problems are the same as those of the oil pipe lines, the engineering problems are quite different and I am not in a position to discuss the economics of gas pipe lines due to a very limited experience with them. I might note here, however, that from the latest analysis of pipe line mileage figures there are approximately 100,000 more miles of gas pipe lines than there are oil pipe lines.

In this paper I have tried merely to hit some high spots in pipe line economic and engineering history, but it is my hope that I have made the point strong enough that in pipe line engineering a man hoping ultimately for an executive or managerial position must be more than an engineer, he must be an economist as well, with vision to see economic trends and translate them into good engineering practice.

* * *

NEWS

Safer Operation Expected From Pressure Research

Research that will aid in strengthening oil transportation pipe lines to prevent recurrence of recent serious rupture damages is now under way at Northwestern University.

Lewis H. Kessler, professor of sanitary engineering, and Merrill B. Gamet, associate professor of civil engineering, working in the University's Technological Institute laboratories, have perfected a test apparatus that makes it possible to determine accurately the bulk modulus of elasticity of any petroleum product, it is announced. This value is then used in computing the speed of transmission of pressure waves and magnitude of the liquid hammer pressures.

This information will help petroleum companies to determine the strength of pipe and amount of reinforcement necessary to prevent the liquid hammer pressure from rupturing the pipe line.

Magnitude of pressure wave also determines how slowly valves in the pipe lines must be closed so that pressure does not rise above a predetermined value based on strength of the pipe material, fittings, and valves.

Interstate Announces Three Staff Changes

Three changes in staff assignments, which became effective June 1, were announced by Interstate Oil Pipe Line Company, as follows:

S. R. Simmons, Shreveport, Louisiana, has been named assistant manager of the southern division in addition to his present duties as division general superintendent.

Joe C. Rawlins, Tulsa, present chief engineer of Interstate, moves to Shreveport as assistant to the manager of the southern division.

E. M. Henderson, former assistant chief engineer of Interstate who has been on special assignment with the pipe line advisor's staff of Standard Oil Company (New Jersey) for the last two years, returns to Tulsa as chief engineer.

Simmons, a veteran of almost 36 years' service with Interstate, the Standard Pipe Line Company, and Standard Oil Company of Louisiana, attained his present position as general superintendent of Interstate's southern division on January 1, 1946. His service with Interstate and its predecessor companies dates back to June 15, 1913, when he was employed as an oiler at the Standard Oil Company of Louisiana's Oxford, Louisiana, pump station.

Rawlins began his pipe line career in 1937 when he joined the pipe line department of Standard Oil Company of Louisiana as an engineer. In 1945 he transferred to the producing department of Standard Oil Company (New Jersey), and a year later became coordinator for the pipe line research program of Standard Oil Development Company. Then, after completing some special assignments in other departments of Jersey Standard, Rawlins returned to Interstate on September 1, 1947, as acting chief engineer, becoming chief engineer on July 1, 1948.

Henderson was first named assistant chief engineer of Interstate's predecessor, the Oklahoma Pipe Line Company on June 1, 1944. On October 12, 1945, he became chief engineer of Interstate's northern division, and on July 1, 1946, he became assistant chief engineer on the Interstate general staff. In March, 1947, he transferred to the pipe line advisor's staff of Standard Oil Company (New Jersey) on special assignment, and it was while on this assignment that he worked with a group of Jersey consultants in developing pipe line plans of Middle East Pipelines, Ltd.

Vitron Pipe Wrap Is Ordered for New Line

Notification of the award of a sizeable order for its products has been received by R. H. Banard, president of Glass Fibers, Inc., Waterville, Ohio. Notification came from Fish Constructors, Inc., of Houston, Texas, acting as agents for Trans-Continental Gas Pipe Line Corporation, and involves 40,000,000 sq ft of underground pipe wrap, trademarked Vitron. The sale was made by M. J. Crose Manufacturing Company, Tulsa, Oklahoma, exclusive foreign and domestic distributors for wrap manufactured by Glass Fibers, Inc.

At its Waterville, Ohio, site Glass Fibers has just completed installation of a new pipe wrap manufacturing unit that embodies the latest technical developments in glass fiber mat manufacturing.

Glass Fibers is a comparatively new company in the fiber field, having been incorporated in 1944.

Completes Sea Trials

Having completed her sea trials, the 12,000-dwt motor tanker *Borgny* has been handed over to her owners, Fred Olsen and Company, of Oslo, by Harland and Wolff, Ltd. The *Borgny's* main dimensions are: Length overall 487 ft 6 in., length b.p. 460 ft, breadth moulded 59 ft, and depth 34 ft 10 in.

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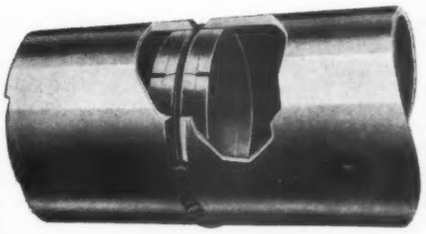

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NEWS

Complex Transportation Job Shown by API Map

To help provide a better understanding of the complex job involved in moving two billion barrels of crude oil annually from the wells to the consumer, the American Petroleum Institute has published an illustrated map showing the routes of pipe lines and the transportation equipment used by the nation's oil men.

Finished in three colors, the map is excellent for reference purposes in schools and libraries, and in all phases of the oil business itself. It gives visual significance to the huge transportation system erected by the oil industry to keep the American public well supplied with petroleum products everywhere.

In addition to the illustrations, it also carries a thumbnail history of the growth and development of petroleum transportation in the United States.

The pipe line routes are super-imposed on a map of the United States. White lines are used to indicate the crude oil pipe lines, and red ones indicate the finished product pipe lines. A blueprint-type chart pictures the standard tankers, barges, tank trucks, railroad tank cars, and pumping stations used in oil.

Currently the petroleum industry is utilizing more than 150,000 miles of pipe lines, 2400 barges, 476 ocean-going tankers, 103,000 railroad tank cars, and more than 250,000 motor vehicles of all kinds, including 147,000 tank trucks and tank trailers in the vast job of delivering to the American public a total of more than 240,000,000 gal of its products daily.

Large Sale Fiberglas To Trans-Continental

O. E. Murrey, president of the Midwestern Engine and Equipment Company, Tulsa, Oklahoma, exclusive national distributor for Owens-Corning Fiberglas underground pipe wrap, announces the sale of 40,000,000 sq ft to the Trans-Continental Gas Pipe Line Corporation, for use on that company's Rio Grande to New York line. This sale, according to the Midwestern official, brings sales of the pipe wrap to more than 100,000,000 sq ft in the last 30 days, and brings Midwestern's total sales for the last few years to 400,000,000 sq ft.

Midwestern, with home offices in Tulsa, maintains sales offices in Houston, Albuquerque, Shreveport, Oklahoma City, and Pittsburgh.

Transportation Facilities Adequate at Present

As a result of increased construction of pipe lines, barges, and ocean tankers, petroleum transport facilities in the United States now in existence or under construction are adequate to meet present requirements as well as those that may be reasonably anticipated in the near future. Ray L. Miller, Dallas regional director of the U. S. Department of Commerce, reports. This conclusion is drawn in a study of petroleum transportation in the January-March issue of the Domestic Transportation Industry Report.

About 149,000 miles of domestic oil lines are now in operation and an intensive program of pipe line construction is under way.

Petroleum transport facilities to meet the long-range needs of the petroleum industry will depend upon the rate of consumption of petroleum products in the United States and the location of future petroleum reserves.

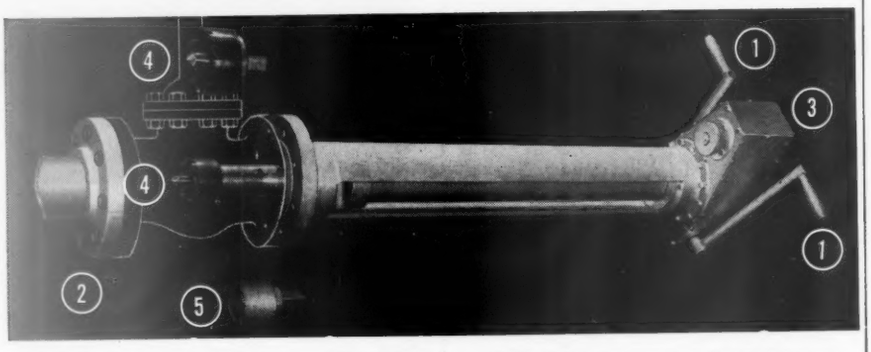
Strong indications exist that the use of petroleum products will continue to increase at a substantial rate if there is no drastic change in the price relationship between oil and coal, Miller said. Estimates included in the study show that domestic demand for petroleum products in the near future will probably exceed the present rate of crude petroleum production in the United States. Important factors in increasing the demand for petroleum are the high rate of production of motor vehicles, the trend of railroads to diesel motive power, and the expanding use of fuel oil for residential and commercial heating.

Future transportation requirements will be largely determined by whether the United States should have to import crude petroleum in increasing quantities or whether domestic sources of supply are relied upon entirely, according to the report.

Among other subjects discussed in the report are: The importance of the petroleum transportation industry, development and location of the domestic petroleum industry.

Prepared by Robert C. Smith, of the Transportation Division, Office of Domestic Commerce, the study measures the importance of petroleum traffic, indicates the traffic pattern for petroleum movements in the United States, and appraises the relative efficiency of the different types of carriers in handling this traffic.

Copies of the report may be obtained without charge from the Department of Commerce, Room 602, 1114 Commerce Street, Dallas, Texas, Miller said.



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NEWS

Brazil Seeks Purchase Of Tankers in Europe

The Brazilian house of deputies has passed legislation enabling the executive power to open a special credit for the purchase of locomotives, refineries, and tankers in Europe, utilizing frozen soft currencies and other funds to be acquired. According to the projected program of expansion, Brazil will purchase a refinery for location at Belem capable of producing 45,000 bbl per day. The government will also seek to increase the capacity of the Bahian refinery, presently under construction, from 2500 bbl to 5000 bbl daily, and to negotiate the purchase of about 180,000 dwt of tankers.

At the same time, the Compahnia Nacional de Gas Esso, a Standard Oil subsidiary, announced the inauguration of bulk transportation of liquefied petroleum gases from Santos to Sao Paulo. Equipment consists of three specially built tank carriers with a capacity of 30,000 gal. There are storage facilities for 238,000 gal at Santos and 90,000 gal at Sao Paulo, while supplies are obtained from Aruba by tanker.

Texas to Virginia Gas Line Proposed

Application will be made to the Federal Power Commission by Coastal Pipe Line Company of Birmingham, Alabama, for permission to construct a 1000-mile gas line from Texas to Virginia, according to Robert Lassiter, Jr., who resigned as counsel for Charlotte Natural Gas Corporation, Charlotte, North Carolina, to handle legal matters for Coastal.

Motor Tankers Ordered

Sir James Laing and Sons of Sunderland, England, are planning to lay the keel by mid-August of the first of two motor tankers of about 23,000 dwt each, on order for Leif Hoegh of Norway. The launching of these vessels will make shipbuilding history at Sunderland, since they are more than 6000 tons larger than any previous vessel built on the Wear. Both of them will be propelled by Doxford diesel engines, and they from part of a contract for five tankers, with an aggregate deadweight of 86,000 on order for Leif Hoegh. They will be built in the East yard where work is proceeding on the construction of a tanker of about 16,000 tons, the largest vessel order at Sunderland for the British Tanker Company.

Phillips Gathering System Sold to Cities Service

The Phillips Pipe Line Company's crude oil gathering system in the Johnson and Foster pools of Ector County, Texas, has been purchased by Empire Pipeline Company, a subsidiary of Cities Services Oil Company (Delaware) according to a joint announcement by Cities Service Oil Company and Phillips Pipe Line Company, a subsidiary of Phillips Petroleum Company. The system consists of approximately 30 miles of pipe line ranging in size from 2 to 6 in., 34 field pumps, 162 tank connections on 40 leases, a central pumping station having a capacity of 12,000 bbl a day, and 30,000 bbl of steel storage tanks. The system is in the center of the prolific Foster and Johnson pools near Odessa, Texas.

Tennessee Gas Earnings Show An Increase

Net earnings from the operation of the natural gas pipe line system of the Tennessee Gas Transmission Company for the first quarter of 1949 totaled $2,093,801, according to the company's quarterly report received by stockholders.

This was equal to 57 cents per share on the 3,333,333 shares of common stock outstanding and compares with earnings equal to 34 cents per share on the same number of shares for the first quarter of 1948.

Average daily deliveries for the first quarter of 1949 amounted to 618,134,000 cu ft, an increase of 76 per cent over the same period last year. Earnings during the remainder of 1949 should increase as new facilities, now under construction, are completed and placed in service, Gardiner Symonds, president, said in his letter.

It was pointed out that the company now has pending before the Federal Power Commission two applications seeking authority to build additional facilities to expand the system capacity to an aggregate of 1,060,000,000 cu ft per day. On May 3 the FPC authorized the company to construct approximately 155 miles of 30-in. loop lines and 4200 additional compressor horsepower to existing compressor stations so as to enable the company to deliver 60,000,000 cu ft daily to the East Tennessee Natural Gas Company for resale to the Atomic Energy Commission plant at Oak Ridge, Tennessee. The company now has FPC authority to expand delivery capacity to 831,000,000 cu ft daily and is engaged in the construction of the facilities needed to attain such deliveries.

Would Construct Line In North Ohio Area

Construction of 72 miles of pipe line in northern Ohio is planned for transportation of 26,000,000 cu ft of natural gas a day for resale to utility companies serving the area east of Cleveland, including the communities of Wickliffe, Willoughby, Grand River, Fairport, Painesville, Geneva, and Ashtabula. Application to FPC was filed by Eugene H. Cole, of Washington, D. C., who plans to incorporate and operate the Erie Gas Service Company, Inc.

Gas requirements of the line would be supplied by Tennessee Gas Transmission Company.

Steel for Canadian Line Being Made

Hon. Colin Gibson, minister of mines and resources, touched a button to start production of 67,000 tons of special steel plate in a ceremony at Hamilton, Ontario, June 1. The plate, which is being made by the Steel Company of Canada, will be used for Imperial Oil's projected pipe line from Edmonton eastward towards new markets.

The order will take 10 months to complete. It is the largest plate order Stelco has ever received and represents 8 to 9 per cent of the company's steel-making capacity over that period.

Civic and government officials and a large group of Hamilton citizens watched as Gibson pressed the button, which released a white-hot, 20,000-lb slab of steel from the heating furnace. The glowing slab first went through a reversing plate mill, becoming longer and thinner, and then on to the hot strip mill, where six stands of rolls reduced the steel to a thickness of 9/32 in. After it left the hot strip mill, flying shears automatically cut the strip into 48-ft lengths, and the plate was piled up ready to be stacked for cooling.

The 450-mile Edmonton-Regina line is a first step in providing an outlet for growing oil production in Alberta, where wells now are on restricted output. Pipe lines are needed to provide low-cost transportation, so that oil in volume can be moved economically to new markets.

H. H. Hewetson, chairman of the board of Imperial Oil, said in a recent address that extension of the Edmonton-Regina line to the head of the Great Lakes in the near future is a development which Imperial is pursuing actively.

Pipe Line—Marine Transportation—Personals

▸ **J. Lyell Wilson,** research director of the American Bureau of Shipping, was elected chairman at the recent annual election of officers for the 1949-1950 season of the Metropolitan Section of the Society of Naval Architects and Marine Engineers. **Warner Lumbard,** vice president of the Simmons Boardman Publishing Company, was elected to the office of vice chairman; **Manlius J. Giraldi,** of the technical staff of the American Bureau of Shipping, was elected secretary-treasurer, and **Everett F. Clark,** eastern marine manager, Westinghouse Electric Corporation, was elected a member of the executive committee.

New working committees for the section have been appointed. The chairman of the papers committee will be **Douglas C. MacMillan,** chief engineer for George G. Sharp, Naval Architect; **John J. Demey,** chief draftsman, Kearfott Company, will head the meetings committee; **Harold M. Wick,** assistant to the president, American Bureau of Shipping, will handle public relations; **Barton B. Cook,** assistant naval architect, Gibbs and Cox, is to head the auditing committee, and **Bengt E. Meurk,** manager, construction and repairs, Isthmian S.S. Company, will be chairman of the nominating committee.

▸ W. M. **Buckmaster,** station engineer at Basile, Louisiana, for Shell Pipe Line Corporation, has been transferred to Neches, Texas. **R. J. Clontz,** field gauger, has been transferred from Kilgore to Cleveland, Texas. **J. T. Davis,** electrical maintenance supervisor, has changed his headquarters from Monahans to Austin, Texas. **C. R. Eller,** station engineer, has been moved from Courtableau to Basile, Louisiana. **W. M. Rainwater,** station maintenance electrician, is now at Odessa, Texas, having formerly been at Hamlin.

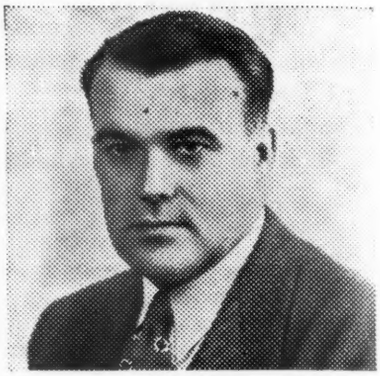
▸ W. E. **Johns,** superintendent of Lone Star Gas Company's Gainesville and Fox compressor stations, has been retired. He entered the employ of the company at Loco, Oklahoma, in 1920 and served as chief engineer of the Gainesville and Fox stations before becoming superintendent. Prior to joining Lone Star he worked for Gulf, Sinclair, and Pure Oil.

▸ **J. B. Harshman,** manager of the pipe line department of the Utah Oil Refining Company, Salt Lake City, Utah, and formerly general manager of Stanolind Pipe Line Company, Tulsa, Oklahoma, has resigned. **H. M. Hill,** superintendent of the Wyoming division of Stanolind Pipe Line Company, has succeeded Harshman, and **Ray K. Strand,** district foreman at Casper, Wyoming, takes over the post vacated by Hill. **Hobart G. Mariner,** area engineer for Stanolind in the West Texas division, has been promoted to assistant superintendent at Casper. **G. L. Maciula,** Stanolind engineer in the West Texas division becomes area engineer. He will have his headquarters at Lubbock.

▸ **Roy F. Ball,** division manager, materials department, Interstate Oil Pipe Line Company, Tulsa, has been elected to membership in The Pipe Liners Club of Tulsa. Other new members are: **E. L. Graves,** sales engineer, The Condit Company, Tulsa; **Robert B. Giezentanner,** district foreman, Interstate Oil Pipe Line Company, Drumright; **W. L. Kennedy, Jr.,** engineer, Stanolind Pipe Line Company, Tulsa; **John H. Keyes, Jr.,** engineer, Stanolind, Tulsa; **Ben D. (Tex) Leuty,** engineer, Cities Service Oil Company, Bartlesville; **DeWitt Lipe,** electrical superintendent, Interstate, Tulsa; **Frank E. McNulty,** district representative, Koppers Company, Tulsa; **Arthur H. Newberg,** chief engineer, Stanolind, Tulsa, and **Roland Phillips,** assistant chief engineer, The Texas Pipe Line Company, Tulsa.

▸ **F. C. Barclay** has resigned as head of the crude oil purchasing department of the Central Pipe Line Company, Salem, Illinois, to form the Barclay Oil Company and the Barclay Indiana Oil Company, both of which have their headquarters at Mount Carmel, Illinois.

▸ **Frank D. Mathias** has been made head of the treasury department of the Panhandle Eastern Pipe Line Company with headquarters at Kansas City, Missouri, succeeding **C. D. Jellings,** deceased. Mathias is a veteran employe of the company and has been assistant treasurer. **Robert B. Cram** is assistant to Mathias.



W. M. Elmer

▸ **W. M. Elmer** has been elected treasurer of Texas Gas Transmission Corporation, W. T. Stevenson, executive vice president of the company announces.

Elmer has been associated with Texas Gas since June, 1947, when he was employed as comptroller of Memphis Natural Gas Company. After the merger of Memphis Natural and Kentucky Natural Gas with and into Texas Gas in April, 1948, he was elected comptroller of Texas Gas.

Prior to joining the Texas Gas organization, he was associated for nine years in the Chicago and St. Louis offices of Arthur Anderson and Company, public accountants and auditors where he devoted a major portion of his time to natural gas and other utility accounting.

Elmer is a resident of Owensboro, Kentucky.

▸ **J. R. (Dick) Ellis** has been elected a director and vice president of the Sunray Pipe Line Company, a subsidiary of Sunray Oil Corporation.

Ellis has been associated with Sunray since May 1, 1947, when he joined the company at Tulsa after more than 10 years of practical pipe line experience with the Great Lakes Pipe Line Company, serving successively as gauger, clerk, chief inspector, and district engineer in various Great Lakes operating areas.

Since joining Sunray, Ellis has headed the company's program of pipe line operations. The pipe line company maintains a products pipe line from Allen to Drumright where connection is made to the Great Lakes pipe line system.

▸ **Roy P. Thielen,** formerly assistant chief engineer at Sneed, Texas, for Panhandle Eastern Pipe Line Company, has been transferred to Liberal, Kansas, as assistant chief engineer. **Wilbur Thorpe,** engineer at Hansford, replaces Thielen at Sneed, and **Rodney W. Mills,** formerly engineer at Centralia, Missouri, is now assistant chief engineer at Hansford.

▸ **John L. Copeland** has been appointed district superintendent at Magnolia, Arkansas, for the Interstate Oil Pipe Line Company, succeeding **T. E. Welsh** who lost his life in an automobile accident. Copeland has been with the company 21 years and an assistant superintendent since January 1, 1945. He was stationed in the Mississippi district until February, 1948, when he was transferred to the Magnolia district.

▸ **C. M. Latham,** maintenance man in the Beaumont, Texas, district for United Gas Pipe Line Company, has been promoted to station attendant. **L. J. Gregoire, Jr.,** station attendant in the New Orleans district, has been made relief dispatcher. **Howard E. Hunt,** formerly relief dispatcher in the Dallas district, is now field dispatcher. **Glenn Alexander, Henry C. Gunter,** and **Fred A. Switzer,** all oiler-engineers in the Dallas district, have been promoted to loader-testers. **T. L. Poland,** maintenance man in the Dallas district, has been made a relief dispatcher. **C. P. Patterson,** who has served in various compressor station capacities in the Shreveport, Houston, Monroe, and Jackson districts, has been promoted to machinist in the Shreveport district. **F. E. Grinnell** relief station attendant in the Jackson district, has been made station attendant. **J. B. Hays,** machinist and shift engineer in the Shreveport district, has been transferred to the general office at Shreveport as chief machinist in the research department.

▸ **W. H. Stueve,** executive assistant of Oklahoma Gas and Electric Company, has been initiated into the Oklahoma University Chapter of Tau Beta Pi, National honorary engineering society, for his outstanding achievements in the engineering field.

Stueve is a graduate of Ohio State University in both mechanical and electrical engineering, and is a member of AIEE and AIMME, a fellow in ASME, and a member of Oklahoma State Board of Engineering Examiners. During World War II he was selected as Chief Electrical Engineer for the "Big Inch" pipelines.

▸ **R. E. Nelson, Jr.** has assumed the post of assistant to the president of the Stanolind Pipe Line Company, J. L. Burke, president, has announced. Nelson will join the pipe line company from the Stanolind Oil and Gas Company where he was manager of the Texas-Louisiana Gulf Coast Division with offices in Houston, Texas.

He attended the University of Missouri, majoring in geology. Nelson completed the advanced management course at Harvard Graduate School of Business Administation. His first oil company job was with the Sinclair Oil Company as a scout.

After a period with the Dixie Oil Company, Nelson was transferred to the Stanolind Oil and Gas Company as a geological scout at Midland, Texas.

Assigned the post of unitization supervisor in 1943, Nelson soon was promoted to superintendent. In 1947, he was made executive assistant to the director of producing and manufacturing for the Stanolind Oil and Gas Company and January 1, 1948, became manager of the Texas-Louisiana Gulf Coast Division.

▸ **W. T. Palmer,** assistant manager of the East Texas-Louisiana division of The Texas Pipe Line Company, has been made assistant division manager of the Basin Pipe Line System. He is moving his headquarters from Joinerville to Wichita Falls, Texas.

▸ **D. R. Welch,** Tulsa, Oklahoma, superintendent of communications for the pipe line department of Sinclair Refining Company, has retired after 32 years' service. Welch's department also had charge of all electrical motors and generators used by the company.

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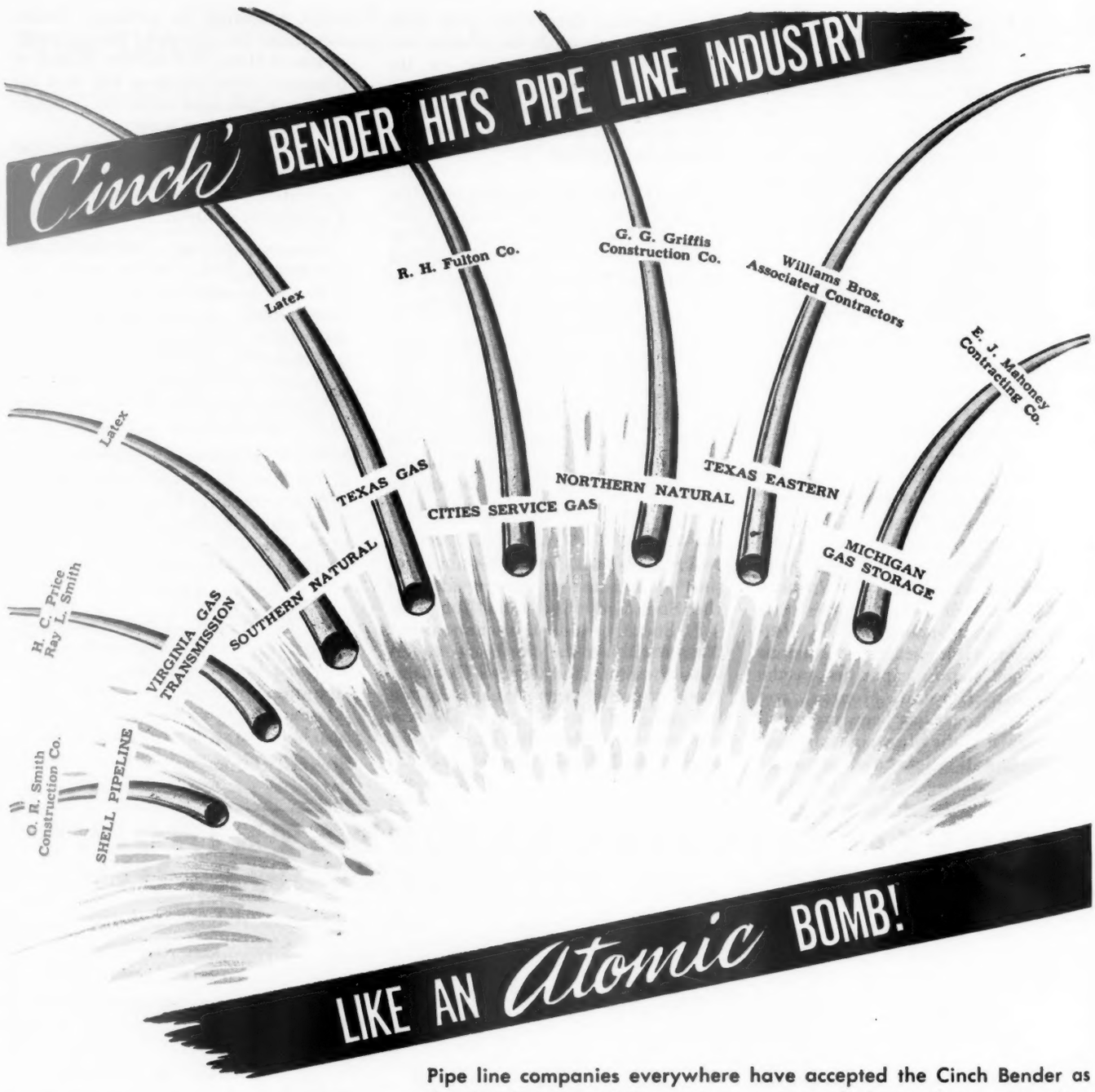

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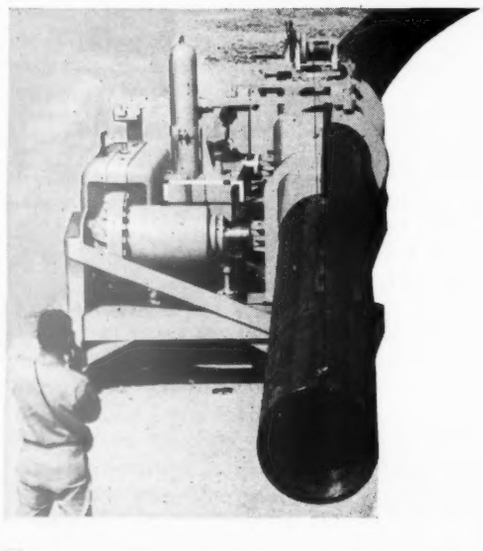

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With the PIPE LINE CONTRACTORS

Oklahoma Contracting Compan, Dallas, Texas, had completed about 60 miles (May 25) of the 180 miles of 22-in. it is laying for Michigan-Wisconsin Pipe Line Company. The section under construction is from Big Rapids, Michigan, to near Crown Point, Indiana. The field office is at Rockford, Michigan. H. A. Wylie is general superintendent, Robert Hall, office manager, and C. W. Goodwin welding foreman. On the 102 miles of 26-in. for Texas Gas Transmission Corporation from Fulton to Providence, Kentucky, approximately 15 miles had been completed. The field office is at Mayfield, Kentucky. L. B. Rea is superintendent, Dick Mueller office manager, and H. A. Rowden welding foreman.

Smith Contracting Corporation, Fort Worth, Texas, has completed Section 2 on the Ozark Pipe Line System of Shell Pipe Line Corporation and Section 3 is scheduled for completion not later than June 15, depending on weather. The two sections extend 157 miles from the Verdigris River, Rogers County, Oklahoma, to Buffalo, Missouri. F. A. Smith is general superintendent. Work on the Basin Pipe Line System of The Texas Pipe Line Company from Wichita Falls, Texas, to Cushing, Oklahoma, has been finished. C. C. Craig was superintendent of this project.

J. L. Cox and Son, Raytown, Missouri, who are stringing 55 miles of 22-in. pipe on The Texas Pipe Line Company's Patoka to Wood River, Illinois, line, had completed approximately 30 miles May 25. J. R. Lyerla is the foreman in charge. Sheehan Pipe Line Construction Company is the laying contractor. Beginning July 1, 39 miles of 26-in. will be strung on the Panhandle Eastern Pipe Line Company system, near Boonville and Pleasant Hill, Missouri. C. S. Foreman Company is the general contractor.

O. C. Whitaker Company, Fort Worth, Texas, has been awarded a contract by United Gas Pipe Line Company for construction of 90 miles of 20-in. pipe line from the Baxterville field, Mississippi, to a point near Mobile, Alabama, and 9.5 miles of gathering lines in the Baxterville field. Jimmy Reid is general superintendent. Two field offices have been established, at Lumberton and Lucedale, Mississippi. Pat Rogan is office manager of the former and Earl Nevins of the latter. This company also has been awarded a contract to lay approximately 90 miles of 26-in. for Texas Gas Transmission Corporation between Greenville and Lula, Mississippi. Barney Hall is superintendent and Lee Price manager of the field office, which is at Cleveland, Mississippi.

Midwestern Constructors, Inc., Tulsa, Oklahoma, began work June 1 on 216 miles of 30-in. line for Transcontinental Gas Pipe Line Corporation from Demopolis, Alabama, to Newman, Georgia. M. T. Wilhite is general superintendent with field offices at Demopolis. The 80 miles of 26-in. for Texas Gas Transmission Corporation will not get underway until July 1 due to delay in pipe shipments. Construction originally was scheduled to begin May 1. This section of line is between Jefferson County, Indiana, and Warren County, Ohio.

Anderson Brothers Construction Company, Houston, Texas, completed this month 203 miles of 22-in. between Springfield, Missouri, and Wood River, Illinois, for Shell Pipe Line Corporation on its Ozark Pipe Line System. Expected to be completed by July 1 are 82 miles of 22-in. for Buckeye Pipe Line Company between Lima and Toledo, Ohio. Two spreads are working, one out of Lima, the other out of Findlay. The spread foremen are Carl Bills and Truman Anderson. Scheduled for completion about June 15 is the 62 miles of 18-in. for The Texas-Empire Pipe Line Company from Patoka, Illinois, north. The field office is at Vandalia, Illinois, with Dewey Whitworth the superintendent. The laying of two loops in Indiana, one in Illinois, and one in Missouri for Panhandle Eastern Pipe Line Company was begun June 1. This is 16-in. pipe and the total mileage to be laid is 45.

Sheehan Pipe Line Construction Company, Tulsa, Oklahoma, has completed 30 miles (May 23) on The Texas Pipe Line Company's 22-in. line from Patoka to Wood River, Illinois. The contractor is laying 55 miles. J. W. Brown is superintendent.

H. C. Price Company, Bartlesville, Oklahoma, is working three spreads on the new 26-in. line of the Atlantic Seaboard Corporation and Virginia Gas Transmission Corporation. Headquarters for one spread is at Petersburg, West Virginia, with Charlie Ice the superintendent. This crew is laying 70 miles from near Mouth of Seneca, West Virginia, to Strasburg, Virginia. From Mouth of Seneca to Cleveland, West Virginia, W. B. Williams is in charge. Headquarters are at Elkins, West Virginia. This is 68 miles. Beginning in July 68 miles will be laid from Strasburg, Virginia, to Atlantic Seaboard's main line near Rockville, Maryland. Two major rivers, the Potomac and Shenandoah, will be crossed. The field office will be at Rockville.

For The Texas-Empire Pipe Line Company 62 miles of 18-in. is being laid from Gibson City to Bethany, Illinois. R. K. Shivel is superintendent; field office, Champaign, Illinois.

Construction operations have begun on 62 miles of 24 and 30-in. for Tennessee Gas Transmission Company between Refugio and Victoria, Texas. The San Antonio and Guadalupe rivers will be crossed. This contract was awarded to H. C. Price Company and Bechtel Corporation as a joint venture, with Price doing the construction work. Field headquarters are at Refugio and Abe Reutzel is the superintendent in charge.

Bechtel-Conyes, San Francisco, California, have been awarded a contract and construction is underway on 62 miles of 18-in. pipe line for the Texas-Empire Pipe Line Company, from Wilmington, Illinois, south across the Kankakee River to a point near Gibson City. Construction began in May. The work is part of a facilities expansion program, which, according to R. B. McLaughlin, president of the Texas-Empire Pipe Line Company, will involve more than 180 miles of 18-in. line extending from Patoka, Illinois, to Wilmington. Patoka is the northern terminus of a group of 20 and 24-in. pipe line systems from the West Texas-New Mexico area.

Bechtel-Price-Conyes, San Francisco, California, is doing grading and right-of-way work on the 506 miles of 34-in. pipe being laid for Pacific Gas and Electric Company between Topock, Arizona, and Milpitas, California.

Williams Brothers Corporation, Tulsa, Oklahoma, will lay the section of line from Newman, Georgia, to Danielsville, Georgia, for Transcontinental Gas Pipe Line Corporation on its 30-in. system from Mercedes, Texas, to New York City. The contract was awarded in May. Williams Brothers is working two spreads between Slaughter, Kentucky, and the Ohio River for Texas Gas Transmission Corporation, a distance of 166 miles. A field office has been established at Hardinville, Kentucky, with Doc Burton superintendent. A second office at Valley, Kentucky, is in charge of Whitey Martin.

Associated Pipe Line Contractors, Inc., Houston, Texas, is laying 122 miles of 26-in. between Somerset and Lebanon, Ohio, for Texas Eastern Transmission Corporation. Personnel includes: J. A. Williamson, general superintendent; L. H. Gray, spread superintendent; A. B. Johnson, office manager; J. N. Lowrance, purchasing agent; W. F. Van Cleave, timekeeper; James Luther, time checker; Roy Connors, right-of-way foreman; Homer Cotter, pipe foreman; W. W. Hudgins, bending foreman; Brit Forse, road crossing foreman; Keller Davis, welding foreman, and Buck Fields, coating foreman.

R. B. Potashnick, Cape Girardeau, Missouri, reports that work began May 25 for Mississippi River Fuel Corporation. Pipe had just begun to arrive at that time and large shipments were not expected until about June 15. From fields in northwest Louisiana to Fredericktown, Missouri, 215 miles of 24-in. will be laid. Several field offices have been established. At Pipe Bluff, Arkansas, G. L. Mims is superintendent, and V. E. Connor office manager. At Newport, Arkansas, Treece Boyd is superintendent, and Robert Bonvillain office manager. Roy Whitworth is superintendent over both the Corning, Arkansas, and Poplar Bulff, Missouri, spreads. Karl Wiist is office manager at Corning and Leo Holliday at Poplar Bluff.

J. R. Horrigan Construction Corporation, Houston, Texas, has begun work on 110 miles of 26-in. line extending from Memphis, Tennessee, northeast. This is on the Texas Gas Transmission Corporation's 800-mile system from Carthage, Texas, to Middletown, Ohio. Field headquarters have been established at Memphis and S. Law is in charge as superintendent.

The contractor also is working on the Michigan-Wisconsin Pipe Line Company project from the Hugoton gas field to distribution points in Michigan and Wisconsin. Last winter the line was completed from Hugoton field to Maryville, Missouri. The present job is 340 miles of 24-in. and 260 miles of 22-in. from Nordaway County, Missouri, to Mecosta County, Michigan. Ben Law is the general superintendent. Spreads are working out of three field offices. J. F. Flannagan is superintendent out of Grant City, Missouri, Louie Visentine is superintendent at Mt. Pleasant, Iowa, and M. E. Shifflet superintendent at Burlington, Wisconsin.

R. H. Fulton and Company, Lubbock, Texas, is working on 130 miles of 26-in. line between Ottawa and Newton, Kansas, for Cities Service Gas Company. The 114 miles of 26-in. loops between Liberal and Emporia, Kansas, for Panhandle Eastern Pipe Line Company has been completed. Work has begun on 74.5 miles of loops across Kansas, also for Panhandle Eastern.

Mahoney Contracting Company, Mt. Pleasant, Michigan, is doing several jobs for Ohio Fuel Gas Company of Columbus, Ohio, including 48 miles of 20-in. and 11 miles of 16-in. lay, and 50 miles of 16-in. takeup. One section being laid is between Seneca County and Sandusky County, another between Sugar Grove and New Albany, Ohio. The work started June 1. A takeup and reconditioning job is being done for Ohio Fuel on 60 miles of 10, 12, and 16-in. in the vicinity of Shelby and Mt. Gilead, Ohio. This work was 60 per cent completed May 25. Offices and warehouses are at Tiffin and Lancaster. Harold Finnerty is general superintendent, Henry Mogg spread man, Bernard Finnerty spread man, Harold Shaw welding foreman, and Don MacDonell office manager.

G. G. Griffis Construction Company, Tulsa, Oklahoma, has been awarded a contract to construct schedule 3 of the Texas-New York line of Transcontinental Gas Pipe Line Corporation. The section is from Jefferson Davis County, Mississippi, to Demopolis, Alabama. Work has begun. This contractor also is working on 57 miles of line for Northern Natural Gas Company, which company is adding loops to its system in Kansas, Nebraska, Iowa, and Minnesota.

N. A. Saigh Company, San Antonio, Texas, began work this month on 103 miles of 20-in. for Texas Gas Transmission Corporation, between Carthage, Texas, and Sharon, Louisiana. Carl Doyle is superintendent.

Morrison Construction Company, Austin, Texas, has been given the contract to lay schedules 1 and 2 on Transcontinental Gas Pipe Line Corporation's 30-in. Texas-New York line. The part of the system laid by Morrison will extend from a point on the Allen-Evangeline parish lines, southwest of Opelousas, Louisiana, to the southeast corner of Jefferson Davis County, Mississippi.

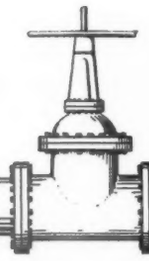
Latex Construction Company, Houston, Texas, is working on 101 miles of 26-in. line for Texas Gas Transmission Corporation between Sharon, Louisiana, and the Mississippi River in the vicinity of Lake Village, Arkansas. Field headquarters are at Farmerville, Louisiana. W. H. Hayes is superintendent and M. L. Thompson assistant superintendent. Latex also is constructing four crude oil pumping stations for The Texas Pipe Line Company. These are at Lindsay, Oklahoma, Haskell, Texas, Colorado City, Texas, and Odessa, Texas. J. B. Latham is superintendent and W. E. Bayless manages the field office.

Eastern Construction Company, Dallas, Texas, began work May 20 on the 78 miles of loops it is laying for Northern Natural Gas Company in Kansas, Nebraska, and Iowa. The pipe is 20 and 24 in. diam. A field office has been established at Washington, Kansas. J. W. Arthur is general superintendent, E. A. Black spread foreman, and Fred Harwell office manager. The Lone Star Gas Company line between Opelika and Dallas, Texas, has been completed.

Fish Constructors, Inc., Houston, Texas, handling the overall contract for construction of the Transcontinental Gas Pipe Line Corporation from Texas to New York City, announces work has begun.

Britton Contracting Company, Inc., Washington, Pennsylvania, is working on a job for the Home Gas Company involving laying and takeup of 30 miles of 4 and 12-in. field lines in the Dundee, New York, area. C. F. Hahn is superintendent and the field office is at Watkins Glen, New York. The contractor also has two jobs underway for Manufacturers Light and Heat Company. One is a lay and takeup job in the Majorsville, Pennsylvania, area, consisting of 30 miles of 4 and 10-in. field lines. A field office has been established at Claysville, Pennsylvania, and Floyd Collins is superintendent. The other is laying 10 miles of 12-in. field lines in the Cannonsburg, Pennsylvania, area. The field office is at Cannonsburg and Bob Snipes is superintendent.

PIPE LINE PROJECTS



Pipe Line to Oak Ridge Atomic Plant Authorized

Acting solely on the basis of strong representations made by the Atomic Energy Commission, the Federal Power Commission has authorized East Tennessee Natural Gas Company and Tennessee Gas Transmission Company to build new pipe line facilities for the purpose of supplying 60,000,000 cu ft of natural gas per day to the atomic energy plant at Oak Ridge, Tennessee. Under the proposed arrangement, Tennessee Gas Transmission will sell the required quantity of gas to East Tennessee, which will resell and deliver it to the Oak Ridge plant.

Facilities authorized for construction by TGT include approximately 155 miles of 30-in. loop line along its existing system between central Louisiana and northern Tennessee as well as the installation of approximately 4200 additional hp at compressor stations. Estimated cost of the facilities is approximately $14,000,000.

The pipe line authorized for construction by East Tennessee will be of 22-in. diam and will extend about 172 miles from a point of connection with the TGT line eastwardly to the Oak Ridge plant. Estimated cost of the project is approximately $9,400,000.

East Tennessee was ordered to begin construction by June 15 and to complete the job by January 15, 1950. TGT was ordered to begin construction of its facilities so as to put them into operation by September 1, 1950.

Contracts Awarded for New San Diego Line

Contracts have been awarded for construction of the new San Diego pipe line, it was announced by Vice President F. A. Hough. Pending approval by the Federal Power Commission of transmission of interstate gas through the pipe line, work is scheduled to begin about July 15.

Construction of the 85 mile, 16-in. transmission pipe line is to be a joint project of the Southern Counties Gas Company and the San Diego Gas and Electric Company. Cost of the line is estimated at more than $5,000,000.

Southern Counties awarded the contract for its section of the line to J. E. Young Pipeline Contractor, Inc. San Diego G. and E. awarded its contract to the utility and Van Valkenburgh Construction Company.

When completed, the new line will supply the San Diego area with an additional 40,000,000 cu ft of natural gas a day from the Texas-California pipe line. At the present time, peak deliverability to San Diego is 33,000,000 cu ft a day through the 12-in. Huntington Beach line.

Southern Counties will construct and operate 35 miles of the new high-pressure line from a point near Moreno on the Texas pipe line to the San Diego County line near the community of Rainbow. San Diego Gas and Electric will build the remaining 50-mile section, which will pass through the city of Escondido to San Diego.

It is expected that construction will be completed about November 1, in time to serve San Diego's needs for the winter of 1949-50.

Cities Service to Install More Compressor Facilities

The Federal Power Commission has authorized Cities Service Gas Company, of Oklahoma City, Oklahoma, to install additional compressor facilities aggregating 4790 hp on the company's partially completed 400-mile natural gas pipe line, which will extend from the Hugoton gas field, Kansas, to Kansas City, Missouri. Estimated cost of the new compressor facilities is $1,214,000.

Cities Service also received FPC authorization to abandon part of its Hutchinson, Kansas, compressor station, which the company said it no longer needed because the partly completed Hugoton-Kansas City line now provides sufficient high pressure gas to meet demands in the Hutchinson area.

Installation of the compressor units is described by the company as part of a four-year program for expansion of compressor facilities, as outlined in 1946 when the company originally asked FPC to authorize the 400-mile Hugoton-Kansas City line.

1400-Mile Gas Line From Canada Planned

Frank McMahon, president of Pacific Petroleums, Ltd., of Canada, has announced a project for the construction of a 1400 mile 30-in. natural gas pipe line to run from the northern part of the province of Alberta, Canada, west and then south through passes in the Canadian Rockies to Vancouver, British Columbia, and thence south through Washington and Oregon into northern California.

An act has been passed by the senate and the house of commons of the Canadian parliament and sanctioned by the governor general creating a Canadian corporation, Westcoast Transmission Company, Ltd., for the purpose of constructing and operating the Canadian part of the pipe line. It is expected that an American corporation will be formed to construct and operate the American end of the line and that application will be made to the Federal Power Commission in due course for a certificate of necessity. The completed pipe line is expected to cost about $175,000,000.

It is the intention to begin the pipe line in an area within Alberta lying to the north of Edmonton, where extensive gas reserves are being established incidental to the present intensive search for oil. In this area, numerous companies, both Canadian and American, including Bear Oil Company, Ltd., will share in the sale of this gas.

Both Sunray and Pacific Petroleums, Ltd., have substantial interests in the Bear Oil project.

The proposed route of the pipe line passes through an area to the west of the Alberta and British Columbia border in which a number of gas wells have been brought in. In this area Sunray Oil Corporation has a 50 per cent interest, the balance being controlled by Pacific Petroleums, Ltd. Sunray is a substantial stockholder in Pacific Petroleums, Ltd.

Associated with McMahon, Pacific Petroleums, Ltd., and Sunray Oil Corporation is the investment banking firm of Eastman, Dillon and Company, New York, which will handle the financing of the new pipe line.

1500-Mile Mid-West Line Gets Approval

Authority to construct an $85,000,000 natural gas pipe line connecting, for the first time, the Texas-Louisiana Gulf Coast area gas reserves with the Mid-West has been granted by the Federal Power Commission to the Trunkline Gas Supply Company, Ralph K. Davies, president of the company announced in San Francisco.

The project to supply natural gas on a wholesale basis to other distributors of gas calls for the construction of a 22-26-in. pipe line over 1500 miles long, stretching from the Gulf Coast to connect initially at Palmyra, Nebraska. These new facilities will transport 250,000,000 cu ft per day.

The Trunkline Gas Supply Company was organized in 1947 to construct and operate pipe lines connecting the large natural gas reserves in the Texas-Louisiana Gulf Coast area with the Mid-Western States and thus supply natural gas on a wholesale basis to distributing utilities. The company was formed by Davies, who is also president of the American Independent Oil Company; P. MacDonald Biddison, consulting engineer of Chicago; Carl I. Wheat, attorney of San Francisco and Washington, D. C.; and Lewis MacNaughton, consulting geologist of DeGolyer and MacNaughton, Dallas, Texas.

Trunkline Authorized to Construct 711-Mile Line

The Federal Power Commission has authorized Trunkline Gas Supply Company to construct and operate a 711-mile pipe line from Edge, Texas, to Palmyra, Nebraska, for the purpose of supplying 250,000,000 cu ft of natural gas a day to Northern Natural Gas Company for resale in Nebraska, Iowa, Minnesota, and South Dakota. Estimated cost of the project is $84,340,300.

The facilities authorized include 711 miles of 26-in. main pipe line, 810 miles of lateral supply lines running to gas fields in the Gulf Coast area of Texas and Louisiana, seven compressor stations with a total installed horsepower of 44,800 and other appurtenant facilities.

In approving the project, the Commission selected the Edge-to-Palmyra route in preference to an alternative proposal that would have involved a main pipe line running approximately 200 miles farther east between Lake Charles, Louisiana, and Keokuk County, Iowa. Selection of the westerly route, the Commission pointed out, will mean a saving of more than $5,000,000 in Trunkline's estimated construction costs and a saving of nearly $3,000,000 in construction work that will have to be performed by Northern Natural.

Trunkline was ordered to begin construction of the project by July 1, 1950, and to complete the job by October 27, 1951. It was also ordered to submit to FPC a "definite and firm plan of financing" for the project within 120 days and "a tariff, including rates, charges, classifications, practices, services, rules, regulations, and service agreement" approximately six months before the beginning of operations.

Hearing Postponed on Consolidated Hearing

The Federal Power Commission has postponed until August 22 the hearing previously scheduled to begin May 16 in Washington, D. C., in the consolidated proceeding involving applications by Southern Natural Gas Company and Atlantic Gulf Gas Company for FPC authorization to construct natural gas transmission facilities in the Southwest. The postponement was requested by the companies.

Southern Natural is seeking authorization to construct a 375-mile pipe line extending from Mississippi to Atlanta, Georgia, with extensions to LaGrange and West Point, Georgia, and Lanett, Shawmut, Langdale, Fairfax, and Riverview, Alabama. The company's proposal also includes a 225-mile trunk line from the Mississippi-Atlanta line to Colfax, Georgia, with extensions to the areas of Tallahassee and Jacksonville, Florida; Savannah, Georgia, and Georgetown, South Carolina.

Atlantic Gulf is proposing to build a 1530-mile line from Mississippi to the Georgetown and Jacksonville areas.

Southern Natural has main offices in Birmingham, Alabama, and Atlantic Gulf in Shreveport, Louisiana.

Harper Buys Line

Sale of a 100-mile natural gas pipe line in Louisiana to A. B. Harper of Fort Smith, Arkansas, and associates, was announced by the WAA. The agency said the purchaser submitted a high bid of $5,257,000. The line cost the government $2,718,186.

WAA said that because of the "strong competitive position of the line in the area," it now has an estimated fair value of $6,750,000. Now operated by the Union Sulphur company, the line starts near Lake Charles and extends to Woodlawn, North Tepetate, Lakeside and Chalkley.

Imperial Oil Orders Steel for Pipe Line

Orders exceeding $9,000,000 for steel plate, for its fabrication into high strength pipe, and for other equipment have been placed with Canadian firms, Imperial Oil announces. The material is for the Interprovincial Pipe Line Company's projected line between Edmonton and Regina.

This line is a first step in making western Canadian oil available over a much wider area.

Roughly 67,000 tons of special steel plate were ordered from The Steel Company of Canada, Ltd., at Hamilton, which will make the steel and roll it into plate. It is the largest plate order Stelco has ever received.

Page-Hersey Tubes, Ltd., will fabricate the plate into 457 miles of pipe 16 in. in diam, at their Welland, Ontario, plant. Pipe will be made in three wall thicknesses—114 miles will be 5/16 in., for use near pumping stations where pressure is greater, and 342 miles will be 9/32 in. River crossings will require a heavier pipe, ½ in. in thickness.

In addition to the pipe line itself equipment was ordered for two pumping stations. These will permit movement of approximately 50,000 to 60,000 bbl of oil a day. In planning the line Imperial has made provision for six more pumping stations to be installed as developments warrant. They will enable the line to carry from 100,000 to 120,000 bbl of oil a day.

Pumps for the new stations were ordered from Railway and Power Engineering Corporation, Ltd., and will be made at Three Rivers, Quebec. Engines and speed increasers were ordered from Dominion Engineering Company, Ltd. and will be made at Lachine, Quebec.

The Stelco order represents approximately 10 per cent of the company's annual ingot capacity and will take a year to complete. When in full production Stelco will ship 200 carloads of steel each month from its Hamilton plant. The Edmonton-Regina line, it is expected, will be completed by the end of 1950.

Scurry to Have Line

Pasotex Pipe Line Company is moving in equipment to lay a 22-mile, 6-in. pipe line from the interesting new North Snyder field in Scurry County, Texas, to a point near Colorado City. The line will connect with the Basin pipe line system.

Pasotex is a subsidiary of Standard Oil Company of Texas, largest producer in North Snyder. Oil has been moved from the field by truck.

Transcontinental Line Construction Begins

Ground breaking ceremonies were held in the Shady Grove community 7 miles north of Laurel, Mississippi, May 23, marking the official start of construction on the Transcontinental Gas Pipe Line Corporation's 30-in. Texas-New York pipe line. Claude A. Williams, president of Transcontinental, turned the first spade of dirt. Hugh L. White, governor of Mississippi, participated in the ceremonies. The gas transmission system, which will have its origin at Mercedes, Texas, and terminate at New York City, will have a mainline of 1840 miles. With laterals the system will total 2250 miles.

Fish Constructors, Inc., Houston, Texas, acting as agent for Transcontinental, has awarded a part of the construction contracts, as follows:

Morrison Construction Company, Austin, Texas, schedules 1 and 2. Schedule 1 is from a point on the Allen-Evangeline parish lines, southwest of Opelousas, Louisiana, to a point near New Rhoads, East Feliciana Parish. Schedule 2 is from the latter point to the southeast corner of Jefferson Davis County, Mississippi.

G. G. Griffis Construction Company, Tulsa, Oklahoma, schedule 3, from Jefferson Davis County Mississippi, to Demopolis, Alabama.

Midwestern Constructors, Inc., Tulsa, Oklahoma, schedules 4 and 5, from Demopolis, Alabama, to Newman, Georgia.

Williams Brothers Corporation, Tulsa, Oklahoma, schedule 6, from Newman, Georgia, to Danielsville, Madison County, Georgia.

90-Mile United Line Gets Under Way June 30

A substantial addition to the natural gas supply available to the Mobile and Pensacola areas is expected to be provided before the coming winter. This was indicated in the announcement by United Gas Pipe Line Company that contracts have been let and clearing work has begun to lay 90 miles of 20-in. pipe line from the Baxterville field in south Mississippi to a point near Mobile.

United Gas Pipe Line Company, which delivers gas to a number of Gulf Coast cities, recently obtained authority from the Federal Power Commission to substitute 20-in. pipe for the 18-in. size previously specified for the line from Baxterville. The change increased capacity of the line from 78,000,000 to approximately 100,000,000 cu ft per day.

J. D. Davis, in charge of transmission properties for United Gas in this area, said the entire project should be completed by early in the fall.

Initial work will be on some 9.5 miles of gathering lines for the collection of gas from wells in the Baxterville field, in Marion and Lamar counties.

The main transmission line, consisting of approximately 90 miles of 20-in. pipe, will terminate at Mobile Junction, in Mobile County, where it connects with lines presently serving Mobile and Pensacola. Delivery of the main line pipe is scheduled to begin about June 30, but preparatory work already is under way.

The O. C. Whitaker Company, Fort Worth, Texas, has been awarded the construction contract for the project.

Way Cleared for Trans-Arabian Line

The Syrian government has reached an agreement with Arabian-American Oil Company that allows the Trans-Arabian Pipe Line to cross that country on its way from Saudi Arabia to Lebanon, thus removing a political obstacle that had barred completion of this 1080-mile, $200,000,000 project. Full-scale construction now is expected to begin within a few months. When completed the 30-in. pipe line will transport 300,000 bbl of oil a day from Persian Gulf oil fields through Saudi Arabia, Trans-Jordan, Syria, and Lebanon to the Mediterranean Sea.

Approximately a fifth of the line has been completed at the Saudi Arabian end where Jewish-Arabian disturbances were not felt.

Montana-Dakota Utilities Acquires Additional Gas

R. M. Heskett, president of Montana-Dakota Utilities Company, Minneapolis, Minnesota, announces that the company had recently signed a contract with the Pure Oil Company of Chicago for the purchase of gas from the Worland Unit Area, an oil and gas field near Worland, Wyoming, now being developed by The Pure Oil Company.

"We are planning to bring this new gas supply into the markets now being served by us in eastern Montana, western North Dakota and the Black Hills region of western South Dakota, not later than the fall of 1950," Heskett said.

A new company, the Montana-Wyoming Gas Pipe Line Company, to be publicly financed, is being organized to build this pipe line. Total cost of construction will be approximately $8,000,000. Montana-Dakota will lease and operate the facilities of the new company.

977 YEARS OF EXPERIENCE

The 66 employees of Latex Construction Company participating in our Employees' Retirement Plan during 1948 (eligibility requirement: 5 years or more continuous employment) have a combined total of 977 years of pipeline construction work. These years of experience and specialization are reflected in the efficiency of Latex pipeline construction.

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General Contractors
Oil·Gas·Gasoline·Water Pipelines
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Salt Water Disposals
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CONSTRUCTION CO.
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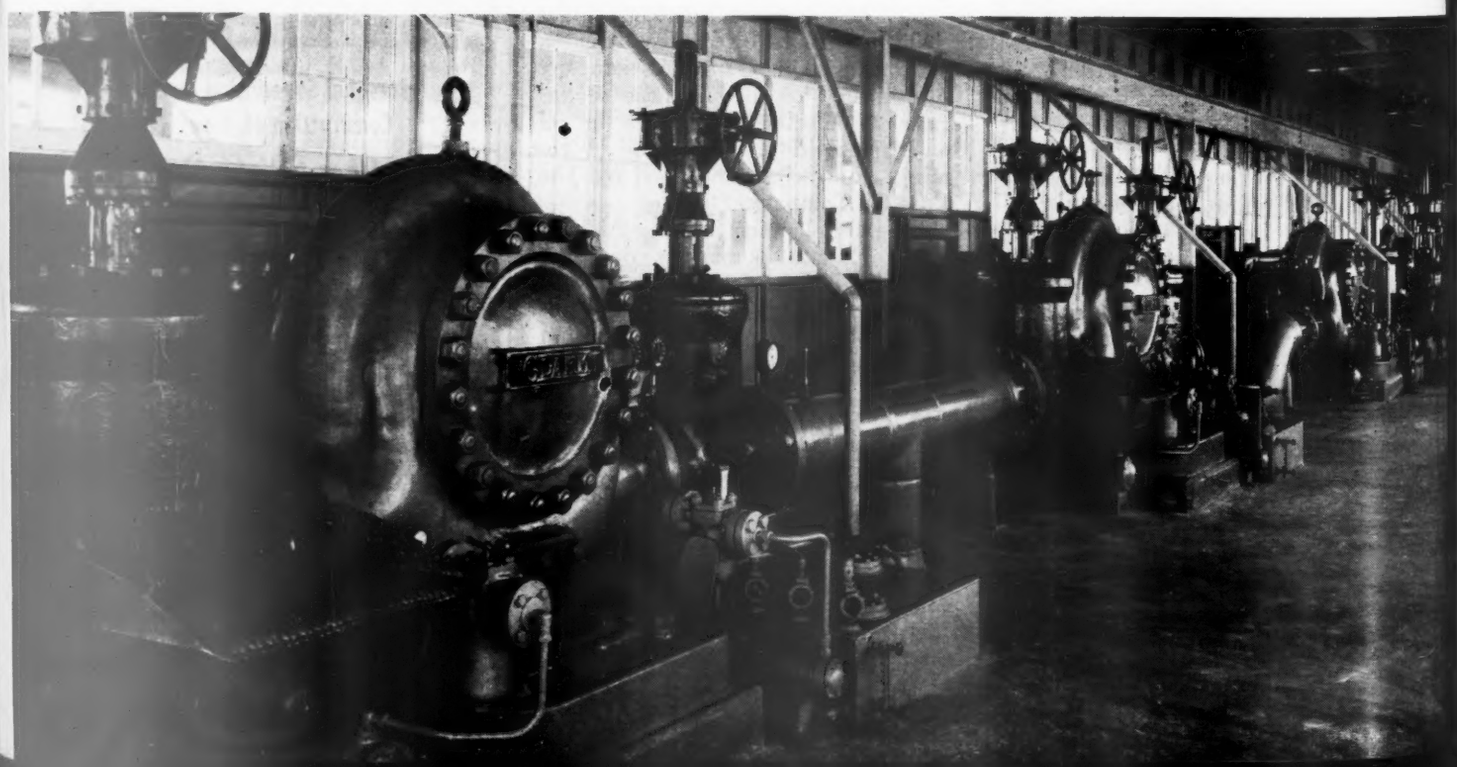
Transportation

"Caterpillar" diesel tractors aid in coating a line near Leeds, Alabama, on job done by Latex Construction Company for Southern Natural Gas Company.

Compressor station building at Poplar Bluff, Missouri, on system of Texas Eastern Pipe Line Corporation.

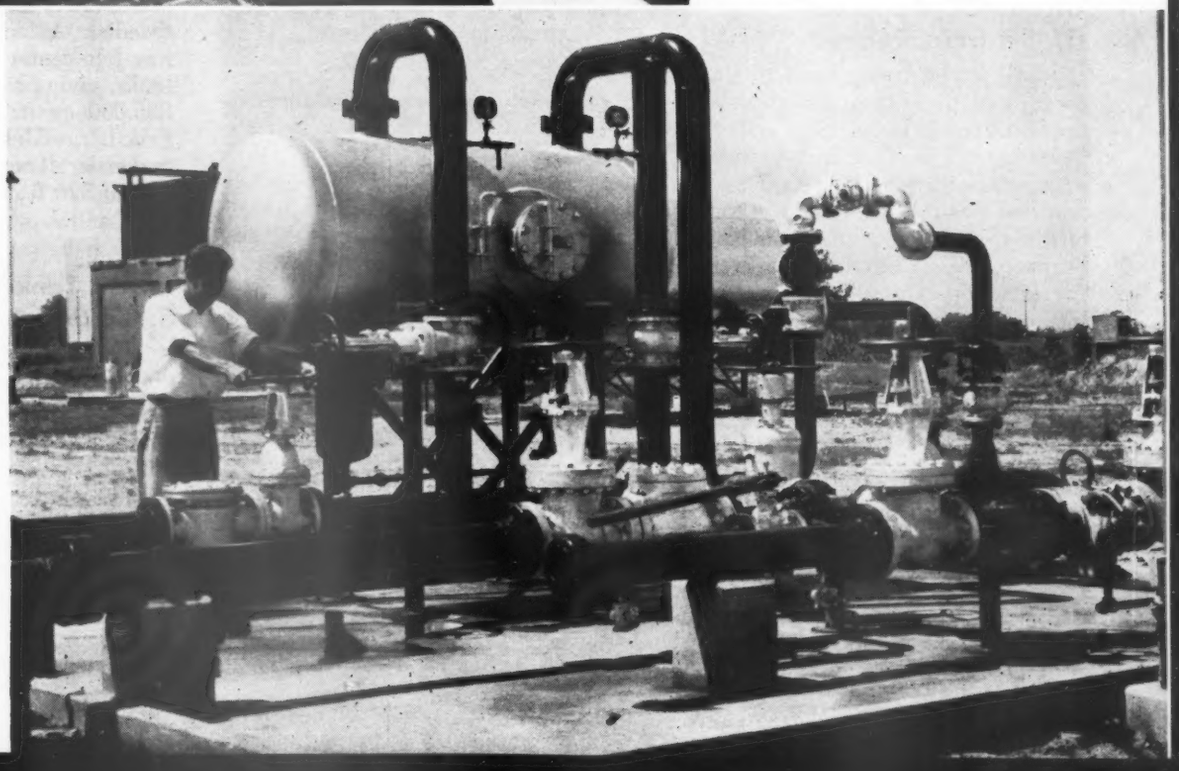
Clark centrifugal compressors installed in Texas Eastern Transmission Corporation's Poplar Bluff, Missouri, station.



Pictorial

"Socony 23", above, of the marine fleet of the Socony-Vacuum Oil Company, Inc., converted recently from steam to diesel to provide an increase in horsepower of 100 per cent and now in service again in the New York Harbor area. Conversion of the vessel was part of a Socony-Vacuum program to rehabilitate and modernize its tug fleet.

Carl C. Whitaker, below, pipe line superintendent for Tennessee Gas Transmission Company, talks over his mobile radio equipment.



Richard Lawrence, chief station operator, turns a manifold valve at Allen, Oklahoma, station of Sunray Oil Corporation.

MARINE OPERATIONS

Tanker Construction Up the First Quarter

Construction of steam and motor tankers of 1000 gross tons and upward each, reported a gain of 139,000 tons during the first quarter of this year with a total of 1,526,833 tons, according to a report by Lloyd's Register of Shipping. Tanker construction in U. S. shipyards advanced from 368,190 to 432,940 tons, whereas that reported for Great Britain and Ireland advanced from 660,728 to 695,210 tons. France indicated a decline from 85,830 to 60,615 tons, while 10,000 tons are reported underway in Japanese yards. Construction of motor tankers throughout the world show a gain, the total rising from 918,644 tons in the December, 1948, quarter to 958,013 in the March period. The total for Great Britain and Ireland was 579,840 compared with 580,908 in the December period. For Sweden there was an increase from 123,000 to 142,970 tons, while Belgium's total increased from 41,700 to 52,700 tons. Holland advanced sharply from 38,200 to 59,400, whereas Denmark registered a decline from 37,530 to 30,530 tons.

Urges ICC Approval Of Seatrain Request

Small lot bulk shipments of liquid cargoes of petroleum and petroleum products from Texas City and New Orleans to New York in competition with established tanker services are reported possible within the near future if recommendations made by the Bureau of Water Carriers and Freight Carriers concerning Seatrain Lines, Inc. are approved. The Bureau has informed the Interstate Commerce Commission that the agency should exempt from regulation proposed service by Seatrain under contracts with shippers for transporting petroleum in the side tanks of its vessels. Each of Seatrain's vessels is equipped with side tanks, ten on each vessel, with a total capacity of 8000 bbl. Asserting that "these tanks cannot be used for common carrier, general cargo or package freight," the company contended that for years it had sought to obtain cargo for the ship tanks, but had been unsuccessful. Application for exemption as a contract carrier has been made on the grounds that competing oil carriers enjoy the same exemption, contending that it would be unfair to regulate the one movement and not the other.

Long River Tows Increase in Number

With the advent of spring, opening of all waterways of the nation to full scale navigation and the seasonal upsurge in production in some basic industries, the long modernized river tows will be seen in increasing numbers, according to a report issued by American Waterways Operators, national association of the barge and towing vessels industry.

The report, issued by Chester C. Thompson, president of the association, emphasized that the most "open winter" in a decade had proved beneficial to the waterway cargo carrying business. "In only a few instances was it necessary to break ice on the Illinois, and the Ohio remained virtually clear throughout the winter, as did the Mississippi south of Rock Island," he said.

The open winter also aided the shipyards situated at such points as Pittsburgh, St. Louis, Mt. Pleasant, Ohio, New Orleans, and other cities, which had been able to continue full scale construction of new tow boats and barges. Good weather helped, plus more adequate allocation of steel and other materials than had been possible in recent years.

As a result, the commercial carriers on the rivers and inland waterways enter the early summer period in good shape to take care of their increasing numbers of shippers of such bulk and basic materials as coal, sulphur, grain, and petroleum products, most commonly associated with water transportation.

Tankers Completed

Completed by Harland and Wolff, Ltd., the motor driven oil tanker *British Workman*, built at the Govan yard, has been handed over to her owners, British Tanker Company, Ltd. Built under special survey of Lloyd's Register to class 100A1 for carrying petroleum in bulk, *British Workman* carries about 12,280 dwt and has a raked stem and cruiser stern, and has been built on the combined longitudinal and transverse system of framing, with two longitudinal bulkheads divided by transverse bulkheads in 27 oil-carrying compartments. Her dimensions are: 463 ft length b.p., 61 ft 6 in. breadth moulded, and depth 34 ft.

The single-screw motor tanker *Siranda* has been completed by Kockums M. V., Malmo, Sweden, for Henry Tschudis Tankrederi A/S of Oslo, Norway. An all-welded vessel of 15,985 dwt *Siranda* has a loaded speed of 15 knots. Dimensions include: length overall 533 ft 3 in.; breadth 63 ft, and depth moulded 38 ft 6 in.

From Gothenburg, there is reported the launching of a new tanker *Bergechief* of 18,000 dwt for Skibs A/S Snefonn of Stavanger. Similar to the *Maricholm*, already delivered to the Swedish American Line, *Bergechief* has ten center tanks and five wing tanks, giving a total cargo capacity of 885,000 cu ft. Being constructed by Eriksbergs Mek. Verkstads A/B, the tanker is all-welded and has a length b.p. of 526 ft; breadth moulded 69 ft 9 in., and depth moulded of 29 ft 3 in.

British Tanker Fleet 3,500,000 Gross Tons

The British tanker fleet at 3,500,000 gross tons is larger than it was in 1939, but even so U. S.-flag tankers equivalent to 300,000 gross tons had to be chartered at a cost of 27.5 million dollars in 1948, according to the British White Paper. The increase in the oil trade is expected over the next few years to exceed the prospective increase in the tanker fleet.

OIL and GAS TRADE NEWS

Products To Be Made in England

Oil Center Tool Company has recently licensed LeGrand, Sutcliff and Gell, Ltd. for the manufacture of its products in England, John Maher, president of Oil Center Tool Company, Houston, Texas, has announced. This will make American-designed oil well pressure control equipment available to oil producing areas throughout the world which operate on a pound-sterling basis.

The pound-sterling is the basis of exchange used throughout the British Empire, and for the purchase of material in other countries where British owned companies operate.

Plant Expansion Made

National Tank Company of Tulsa, Oklahoma, has opened a new plant for the manufacture of petroleum refining and chemical industry pressure vessels, and other equipment. The company's new five-acre plant structure on a 36½-acre site will be devoted to the manufacture and fabrication of gasoline extraction, refining, gas processing, chemical processing and other equipment.

New products to be manufactured in the new National plant will include fractionating and refinery columns; bubble, absorber, distillation and stabilizer towers; chemical tanks of all kinds, debutanizers, depropanizers, vacuum stills and many other refining and chemical processing units.

Companies Are Incorporated

The Lucey Export Corporation has announced the incorporation of Lucey Export (Canada) Ltd., who have taken over the operations of Lucey Equipment (Canada) Ltd., Drilling Supplies, Ltd., and Mineral Sales, Ltd.

Officers of Lucey Export (Canada) Ltd. are W. S. Evans, president, and C. E. Paradice, vice president, New York City; E. M. Wilkinson, managing director; J. J. Saucier, K. C., director, and H. W. Miles, sales manager, of Calgary, Canada.

New Agreement Made

A new distribution agreement between the Worthington Pump and Machinery Corporation and the Midwestern Engine and Equipment Company of Tulsa, Oklahoma has recently been announced. Worthington, which operates nine manufacturing plants throughout the United States and six factories in foreign countires, stated that Midwestern would henceforth carry a full line of constructional equipment for the Worthington Company.

O. E. Murrey, president of Midwestern, said that the company will carry the full Worthington line in contractor's equipment, including the Ransome "Blue Brute" concrete mixers and pavers.

Announces New Loader

A new materials handling loader, called the TL-W Tracto-Loader, is now manufactured by Tractomotive Corporation, Deerfield, Illinois. It is mounted on rubber tires and has a one-half cu yd bucket over the driving wheels and the steering wheels in the rear.

The TL-W's overall length, 12 ft with bucket down, and width, 5 ft 9 in. (outside tire measurements) make it small enough to be used where working areas are limited. It is sold exclusively through Allis-Chalmers.

New 38-lb Paving Breaker

A new paving breaker, weighing 38 lb, has been added to the Gardner-Denver line as a companion to the B67 and B87 heavier machines. Known as the B37, the new paving breaker includes a renewable chuck liner and a hammer of the block type, pistol type.

Gas Turbine To Be Built

An experimental gas turbine specifically designed for installation in gas pipe line service will be built for the Tennessee Gas Transmision Company jointly by Clark Brothers Company, Inc., Olean, New York, one of the Dresser Industries, and Frederic Flader, Inc., North Tonawanda, New York, it was announced by C. Paul Clark, president of Clark Brothers.

With an expected thermal efficiency of more than 30 per cent, the new turbine, a gas-fired unit, will develop 5500 hp to drive a centrifugal compressor to be installed in the Tennessee company's gas line near Moorehead in Eastern Kentucky.

A plant tour at Midwest Piping and Supply Company, Inc., St. Louis, Missouri, climaxed a four-day meeting in that city for Shell Oil Company engineers and refinery officials, some representing Shell installations abroad. Here a section of the group of 30 visitors views one of Midwest's fabrications. They are: John H. Valcik and W. A. Gabig, engineers at Shell Chemical Corporation, Houston, Texas; J. L. Miller, superintendent of operations at the Houston refinery; H. Kost (back to control), of Midwest; William Cowgill, Shell's transportation superintendent at Houston; J. H. Stoffel, of Midwest; H. A. LeBlanc, chief inspector for Shell at Norco, Louisiana; E. H. Tedford, refinery engineer at Montreal, Canada; and S. C. Harris, maintenance supervisor at Norco.

Distributors Selected

Dallas Manufacturing and Sales Company of Dallas, Texas, has been announced sole distributors in the United States and all foreign countries for Gro-Cord, pipe repair gaskets.

C. E. Sherman, president, states that Gro-Cord is in use by all major oil and pipe line companies for making temporary repairs. The gasket, formerly marketed by the Gro-Cord Rubber Company of Lima, Ohio, comes in roll form in many widths. It may be used over leaks in conjunction with a welded plate repair or with a chain jack. The gaskets will hold a 1600 psi pressure and has been in actual service on temporary repairs as long as five years.

Houston Station Opened

The jet method of oil well perforating is now available to operators in the Houston and South Texas area since Welex Jet Services, Inc., opened its Houston station. Cecil Puryear is manager of the new station. The Houston branch is Welex's fourth. Others are in Odessa, Texas, Wichita Falls, Texas, and Ardmore, Oklahoma, with home offices in Fort Worth, Texas.

Big Compressor at Billings

A giant centrifugal compressor—with the energy equal to that in 26 fire-engine pumps or 26,000 electric fans—will be used to help make high octane gasoline at Continental Oil Company's $9,500,000 refinery under construction at Billings, Montana.

The compressor, which weighs 35,000 pounds, is the largest ever made by Carrier Corporation and has a capacity of 1,500,000 cu ft of air per hour.

ACF Hits New High

For the second consecutive month the American Car and Foundry Company has broken its previous freight car production records. During April, 1949, 3249 cars for domestic freight service were delivered to American railroads.

Merger Announced

Announcement is made of the merger recently effected by the France Packing Company and the France Manufacturing Company, both of Philadelphia, Pennsylvania, into the France Packing Company. Both plants will continue in operation under the new management according to Mr. E. A. France, president of the new company, and will remain at the same location.

The France Packing Company (parent company), was founded in 1897 by A. W. France, a practical steam engineer who was a pioneer and recognized authority in the packing field. The France Manufacturing Company was formed by his son, E. A. France, in 1927, who started on his own with the definite purpose of developing packing designs adaptable to an entirely new and broader field of application.

Dallas Is Site of New Location

Fritz W. Glitsch and Sons, Inc., have moved into their new plant in Dallas, Texas. Fabricating bubble trays and caps for the petroleum industry for many years, the company built in the new Dallas industrial section to provide additional expansion on the company's 18 acres. Complete fabricating facilities for the manufacture of carbon steel and alloy trays and caps, tower internals and pressure vessels are provided in the one plant.

J. W. Anderson Promoted

James W. Anderson has been made sales manager of the Whitney Chain and Manufacturing Company, division of Whitney-Hanson Industries, Inc., Hartford, Connecticut, according to an announcement by W. H. Whitney, chairman of the board of directors. Anderson has been assistant general sales manager, and since last fall has made his headquarters in Hartford, to which place he moved from Dallas, Texas.

James W. Anderson

Anderson had had his headquarters in Dallas since 1934, moving there to establish an oil country sales organization for his company. His duties in arranging distributor outlets and appointing salesmen took him into all active oil areas of the United States and South America, and, quite naturally, he is a member of NOMADS.

Andy has a host of friends in the petroleum industry who will be pleased to hear of his deserved promotion.

Sales Representatives Named

Van Hala Industrial Sales Company, Cleveland, Ohio, has been appointed exclusive Kieley & Mueller, Inc., New Jersey, sales representative in the Cleveland area. The Van Hala company will handle the complete K & M line of control equipment.

As sales representative in Mexico, K & M has appointed Schlutz and Martinez, S. de R. L., Mexico D. F. Ing. Rosendo Caballero, Monterrey, Mexico, will handle the K & M products in Northern Mexico, and in Southern Mexico, the line will be handled by Ing. Virgil E. Schultz and Ing. Rodolfo Martinez.

Standco Suffers Fire Loss

The plant of Standco Brake Lining Company in Houston, Texas was partially destroyed by a fire which originated from a welding torch April 12. The fire was confined to one building which housed the asbestos yarn manufacturing department. Estimated loss of machinery is over $200,000 and the value of the burned building is estimated at approximately $30,000.

Export Agents Chosen

Rector Well Equipment Company, Inc., Fort Worth, Texas, has recently appointed Champion and Smith, Inc., as their exclusive export representatives in all territories outside the United States and Canada for Rectorhead tubing and casing heads; cementing equipment; Rectorseal, and other Rector equipment. Champion and Smith, Inc. have offices in Houston, Texas, New York, and Los Angeles, California.

Plant Begins Production

The Marley Company, Inc., manufacturer of water cooling towers, nozzles and dry surface coolers, has started production in a new plant at Louisville, Kentucky, with C. W. Zimmerman as plant manager.

The Marley Company operates two other plants—at Kansas City, Kansas, and Stockton, California.

Eggelhof Engineers

Gordon R. Catts, Jr. has been appointed division sales engineer by Eggelhof Engineers to cover South Texas with his office to be in Corpus Christi, Texas. General offices for Eggelhof Engineers are in Dallas and Houston, and division offices are situated in San Antonio and Lubbock, Texas, New Orleans and Shreveport, Louisiana. It is anticipated that a division office for Oklahoma, probably in Tulsa, will soon be announced.

TRADE PERSONALS

▸ J. P. Magoffin, general sales manager Patterson-Ballagh, Division of Byron Jackson Company recently announced the addition of **George Kerbo** as sales representative at the Odessa, Texas office. Kerbo has been with Patterson-Ballagh for three years and goes to Odessa from the office at Casper, Wyoming.

▸ **Davis Bovaird** has been elected president of the Bovaird Supply firm, following the death of his brother, W. M. Bovaird, former president. The newly elected president joined the

Davis Bovaird

Bovaird firm at Independence, Kansas in 1920.

Serving as directors of the firm with Davis Bovaird are his brother, F. D. Bovaird, vice president; Roscoe G. Ayers, vice president and general manager of sales; R. M. McMahan, secretary-treasurer; and A. E. Booth of Bradford, Pennsylvania. M. B. Park is assistant secretary-treasurer.

▸ The Lincoln Electric Company has announced the election of three additional members to its board of directors. The new directors are **G. F. Clipsham,** assistant to the president, **William Irrgang,** director of plant engineering, and **L. K. Stringham,** director of welding development. The election of these Board members raises the total on the Board of Lincoln to 13.

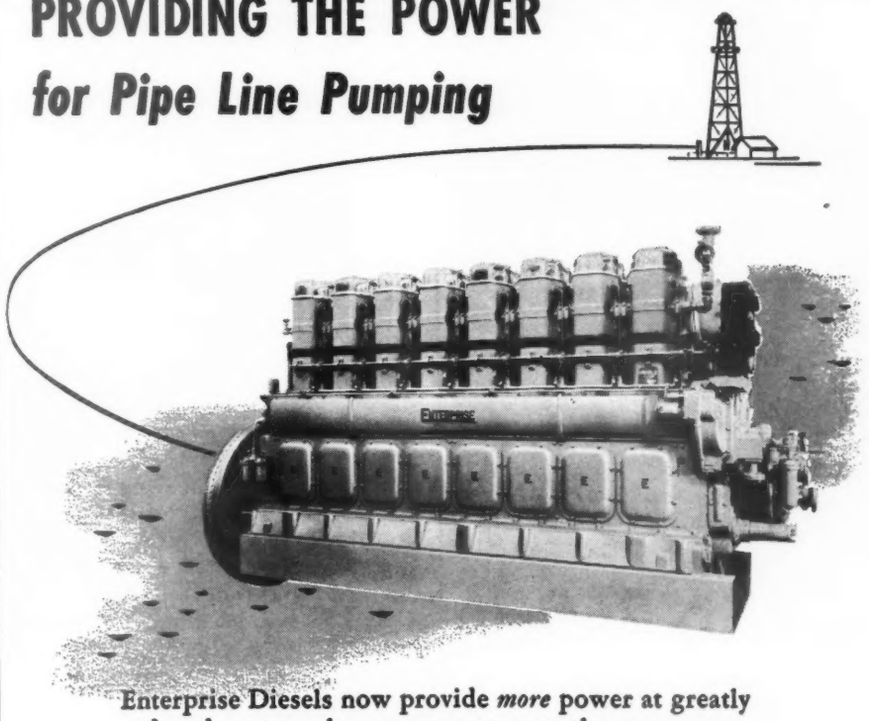
Clipsham and Irrgang joined The Lincoln Electric Company in 1929 and Stringham has been with the company since his graduation as an electrical engineer from Cornell in 1933.

▸ **J. W. Hampton** and **B. M. McCaskill, Jr.,** have been added to the field staff of the Visco Products Company. Hampton is making his headquarters at Duncan, Oklahoma, and McCaskill will be at Tyler, Texas.

▸ Harry A. Burdorf, vice president of sales for The Lunkenheimer Company, announces the appointment of **Harold H. Layritz** as sales manager and **Roland J. Sardieck** as assistant sales manager.

Layritz a graduate of the University of Cincinnati and for a number of years national secretary of Triangle Fraternity, joined The Lunkenheimer Company in 1920. Sardieck went to work for The Lunkenheimer Company in 1918. In recent years he has been Philadelphia branch manager. Returning to Cincinnati, he takes over the position vacated by Layritz.

PROVIDING THE POWER
for Pipe Line Pumping



Enterprise Diesels now provide *more* power at greatly reduced cost per horsepower to meet the most exacting demands required in pumping service. Substantial economies are offered through 1) simplicity of connection and control, 2) high torque at all speeds, and 3) elimination of transmission losses. They are designed and built to withstand heavy punishment from excessive pumping loads. Smooth, even, vibration-free operation is characteristic of this precision equipment.

Whatever your pumping power requirements, check Enterprise Diesels first. You'll find them flexible to your needs, using Diesel oil, modified crude oil, natural gas or dual-fuel. Normally aspirated or turbocharged up to 1800 HP per unit. Write or call for information on your particular power problems.

Builders of Heavy Duty Engines and Equipment Since 1886

ENTERPRISE Diesels

ENTERPRISE ENGINE & FOUNDRY CO.
18th and Florida Streets • San Francisco 10, California
With Branch Offices in Houston and Fort Worth Serving the Oil Industry

Effortless way to reduce Pumping Costs!

Specify DARCOVA valve cups, seating cups and rings

The Original composition valve cup ...still the best!

• Precise control of all materials and processes from lab to well means exceptional resistance to wear and deterioration . . . fewer pulling jobs! • Different textures, scientifically developed, fully proved, give peak efficiency and longer flex-life at *any* depth! • Accurately controlled sizes for any make or size pump . . . no misfit inefficiency! • Ask for *genuine* Darcovas at your supply store.

DARLING VALVE AND MANUFACTURING CO.

Williamsport 2, Pa.

DARCOVA

THE ORIGINAL COMPOSITION CUP

▸ **Al Toben,** Rocky Mountain area sales representative for the Cardwell Manufacturing Company, Inc., has been moved to Denver, Colorado. His headquarters were formerly in Casper, Wyoming. Toben will continue to travel through the Rocky Mountain area.

▸ **E. A. Bertram** has been named manager of sales for the Brown Fintube Company, Elyria, Ohio. In his

E. A. Bertram

new capacity he will be in charge of all selling of the company's products in the petroleum and chemical industries through its representatives in the principal cities of the United States. Bertram is a graduate of the University of Illinois and, also, received a M. S. degree in Chemical Engineering from the California Institute of Technology. He is a member of the American Institute of Chemical Engineers and the American Society of Mechanical Engineers.

▸ **Ernest G. Unrath,** former general superintendent of the Ambridge plant of the Spang-Chalfant Division of The National Supply Company, has been promoted to works manager of the plant. He has been with the company since 1931.

S. H. Kilmer, whose service with National Supply dates back to 1917, has been appointed general superintendent at Ambridge, Pennsylvania. For the last 19 years, Kilmer had served as superintendent of inspection at the plant.

▸ **C. L. Lindholm** of Valparaiso, Ohio, has been appointed assistant superintendent of the Roll Department at Harbor Works of The Youngstown Sheet and Tube Company of Ohio. Lindholm was draftsman and assistant to the superintendent of Gary Works of Carnegie-Illinois Steel Corporation before joining The Youngstown Sheet and Tube Company.

▸ **John S. Case** has been named vice president in charge of engineering and production of Anchor Post, Inc.

Don Wooden will assist Case as assistant chief engineer in charge of the fluid heat domestic division. Wooden joined Anchor Post Products, Inc. in 1938 after completing 4 years at Johns Hopkins University.

C. W. Woollen will also assist Case as assistant chief engineer in charge of fluid heat's specialized heating division. Woollen came to Anchor Post Products, Inc. in 1947, as a research engineer.

▸ Bethlehem Supply Company announces the transfer of **M. A. Daigle,** field representative, from Natchez, Mississippi, to Baton Rouge, Louisiana. Daigle has been employed by Bethlehem since March 1940 with the exception of four years naval service during the war.

▸ **Edward L. Lockman's** appointment as manager of tank lining and roll covering sales for United States Rubber Company was announced by Frank M. Urban, merchandise manager of the company's mechanical goods division. Lockman, a graduate of Massachusetts Institute of Technology, is a veteran of 15 years with the rubber industry.

▸ **Jack McKay,** assistant to the director of sales, has been appointed manager of advertising and public relations of Fluor Corporation, Los An-

Jack McKay

geles, California. Starting at Fluor in 1942, McKay has served in purchasing, sales engineering, and as a district sales engineer in Kansas City, Missouri, and Los Angeles, California.

▸ **Amos Johnson,** has recently joined the field sales department of Stoody Company, manufacturers of hard-facing alloys. He has been assigned to assist Stoody distributors in Minnesota and the Dakotas.

▸ Link-Belt Company announces the following promotions:

Allan Craig, sales manager of the company's southeastern division since 1945, is being transferred to Houston, Texas, in the capacity of general manager of the southwestern division, where a new Link-Belt plant is to be opened.

Michael J. Perry, district manager at Moline, Illinois, since 1946, has been appointed sales manager, southeastern division, to succeed Craig in that capacity.

Andrew K. Kolar, district sales engineer at Moline, Illinois, since 1947, has been appointed district manager, in full charge of this office.

John D. Riley has been appointed district manager at Newark, New Jersey, to succeed the late George E. Ramsden.

▸ **Leland I. Doan,** president of The Dow Chemical Company, has announced the promotion of **Donald Williams** from general sales manager to director of sales, the latter position having been vacated by Doan when he became president following the death of Dr. Willard H. Dow.

Williams in turn has announced the appointment of **Donald K. Ballman,** former assistant general sales manager, to fill the position of general sales manager and of **Dr. L. S. Roehm** to the post of assistant general sales manager.

▸ **Frank Champion,** Houston oil man, has been elected president and general manager of the Spartan Tool

Frank Champion

and Service Company. The board of directors has also announced election of **Turner Briggs** as vice president in charge of sales. Champion will take charge of the company's operations immediately.

Graduate engineer of the University of California, Champion is former president and general manager of Wright Drilling Company.

▸ **F. W. Bremmer,** 25 years with The National Supply Company, has been elected vice president in charge of manufacturing. He was appointed works manager of the division's Etna, Pennsylvania plant, in 1940, a position he held until his appointment as works manager of the Ambridge plant last year.

▸ **Kenneth B. Ris,** vice president in charge of sales, Griscom-Russell Company, has been elected president of

Kenneth B. Ris

the company by the board of directors, following the retirement of Russell G. Jones. Jones, who has been with the company 40 years, retired as president, but will continue to act as director.

Ris entered the Griscom-Russell employ in 1922. He has served in the engineering department, various sales offices, as manager of the petroleum sales division, and sales manager. In 1946 he was elected vice president in charge of sales, and a director in 1948.

Charles D. Steffens has been elected vice president—sales, and **James W. Elizardi,** vice president—petroleum sales, of the Griscom-Russell company.

▸ **Lew E. Wallace** was named general manager of sales and **Jay W. Owings,** assistant general manager of sales in promotions, it was announced by The Youngstown Sheet and Tube Company recently. Wallace is succeeded by **John P. Feagley,** who has been with the company for 17 years. For the past 16 years Wallace has been manager of the company's New York Sales office, joining the company in 1915. In his new position he will have two assistants, **Myron H. Watkins,** and Owings.

Another promotion was that of **Phillip G. (Jerry) Boyd,** who has been appointed Chicago district sales manager for The Youngstown Sheet and Tube Company, succeeding Arthur Purnell, who died April 1.

YOUNG

ANNOUNCES THE "HC"

HORIZONTAL CORE

ANOTHER VERSATILE VERTICAL AIR DISCHARGE UNIT FOR . . .

✓ Jacket Water Cooling
✓ Oil Cooling
✓ Gas Cooling, Condensing
✓ Steam Condensing

Basic "HC" Unit may be used in multiples for greater cooling capacity or combination of services.

IMPORTANT FACTS ABOUT THE "HC"

- LOW COST—small initial investment, economical maintenance.
- VERTICAL AIR DISCHARGE—eliminates cross wind effects.
- HIGHLY EFFICIENT—airfoil section fan.
- MULTIPLE INSTALLATIONS — provide greater capacity, combined services.
- NO VIBRATION—adjustable pitch fan mounted separately from unit.
- LARGE CAPACITY—water cooling, from 600,000 Btu/hr up; oil cooling, from 20,000 Btu/hr up.
- LOW HP REQUIREMENT—1 to 10 hp per fan.
- EASY INSTALLATION—simplified piping and frame construction.
- CORE GUARD SCREEN—protects cores from falling objects.

The dual coil "HC" Units, in four sizes, with 2, 4, 6 and 8 coil installations, provide exceptional versatility in heat transfer service. The 4 or 6 blade fan, may be mounted directly on the fan motor shaft, or powered by a v-belt or gear speed reducer drive. Write for full details.

YOUNG Young Quality

HEAT TRANSFER PRODUCTS

OIL FIELD, HEAVY INDUSTRIAL, MUNICIPAL & CHEMICAL PROCESS COOLING EQUIPMENT

Engine jacket water coolers • Oil coolers • Steam and natural gas condensers • Natural gas coolers • Evaporative coolers and condensers • "VAD" Vertical air discharge cooling and condensing units.

AUTOMOTIVE PRODUCTS

Gas, gasoline, Diesel engine cooling radiators • Heat exchangers • Intercoolers • Oil coolers • Supercharger intercoolers

HEATING, COOLING AND AIR CONDITIONING PRODUCTS

Convectors • Unit heaters • Heating coils • Cooling coils • Air conditioning units • Evaporative condensers

AERONAUTICAL PRODUCTS

Oil coolers • Supercharger intercoolers • Radiators • Heat exchangers • Valves • Regenerators

YOUNG RADIATOR CO.

General Offices: Dept. 219-F, Racine, Wisconsin
Plants at Racine, Wisconsin, and Mattoon, Illinois
DISTRIBUTORS • The Happy Company, 310 E. 10th St., Tulsa 1, Oklahoma. A. R. Flournoy Co., 5043 Santa Fe Ave., Los Angeles 11, California. H. J. Young, 1364 Lake Shore Drive, Muskegon, Michigan. Others in Principal Cities.

▸ **C. F. Bonnet** has been named production manager of The American Cyanamid Company's industrial chemical division, and **G. W. Russell,** assistant sales manager of the same division.

Bonnet has been with Cyanamid for more than 15 years. Russell, in his new capacity, will take over the sales duties previously handled by Bonnet.

▸ **George A. Hays, Jr.,** of Tulsa, Oklahoma, has been named director of market development of Oil Well

George A. Hays, Jr.

Supply Company, U. S. Steel subsidiary, M. F. Hazel, general manager of sales, has announced. His headquarters will be at Tulsa.

Hays was connected with Wilson-Snyder Manufacturing Division and its parent company, Oil Well Supply, for 24 years prior to 1946, when he resigned to become associated with Hinderliter Tool Company at Tulsa.

▸ **Ernest L. "Lon" Holter,** for four years electrical service engineer for the McCullough Tool Company, Los Angeles, California, has been transferred to the McCullough, Casper, Wyoming branch. Holter will help introduce and service several of the latest McCullough oil well devices in the Rocky Mountain Area.

▸ Recent personnel changes in the sales department have been announced by Le Roi Company of Milwaukee, Wisconsin. **Thomas V. Shea** has been named general sales manager, **J. E. Heuser,** industrial engine sales manager, **E. F. H. Dutton,** Eastern district manager, and **Clyde R. Schuler,** sales engineer for industrial engines.

▸ Four appointments in Oil Well Supply Company's Eastern Division have been announced by C. H. Maynard, division manager for this U. S. Steel subsidiary.

Seymour L. Brown, has been named district material supervisor of the Michigan district, with headquarters at Mt. Pleasant, Michigan. He is succeeded by **William F. Corbin.**

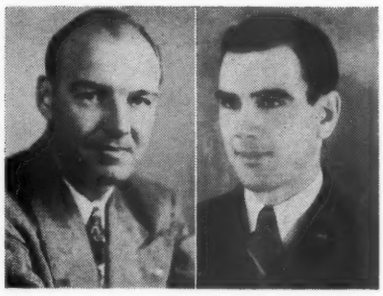
Carl R. Nelson has become assistant district material supervisor of the Pennsylvania district, with offices at Bradford, Pennsylvania.

E. E. Branson, warehouse supervisor at Columbus, Ohio, has been transferred to Charleston, West Virginia as assistant district material supervisor of the Ohio-West Virginia district. Branson, who has been with Oilwell since 1944, is succeeded by **F. B. Lane,** who has more than 28 years service with the company.

In the central midwest, **M. S. Nicklas** has been named district material supervisor for the East Texas, North Louisiana and Arkansas district. Nicklas, is the former manager of "Oilwell's" El Dorado, Arkansas, branch store. He is succeeded by **Frank W. Bruner, Jr.**

▸ **James Webb Gosselin,** 27, son of E. N. Gosselin, president of Graver Tank and Manufacturing Company, Inc., East Chicago, Indiana, and of Phoenix Manufacturing Company, Joliet, Illinois, was killed recently in an automobile accident in Chicago, Illinois. He had been with Graver since 1947, and at the time of his death was production manager at the East Chicago plant.

▸ **Lester B. Swan,** Dowell Incorporated district manager at New Orleans, Louisiana, has been named general manager of United Oilwell Service, S.A., in Caracas, Venezuela. The announcement of Swan's appointment



L. B. Swann C. L. Powell, Jr.

was made by John G. Staudt, vice president and general manager of Dowell. **Herbert Hoover, Jr.,** son of former President Hoover, was elected president of United Oilwell Service in February, and **Charles L. Power, Jr.,** district development engineer in Lafayette, Louisiana, has been named district manager in New Orleans.

United Oilwell Service is an associate company of Dowell.

▸ **John W. Humphrey,** formerly executive vice president of the Philip Carey Manufacturing Company, Cincinnati, Ohio, was elected president at a recent board of directors meeting. Also, **L. W. Clarke** was elected vice president in charge of sales. Humphrey succeeds Robert S. King, who became chairman of the board, and Clarke replaces E. W. Smith, who resigned.

▸ **Monty Mann,** active in the advertising agency business in the Southwest for more than twenty years, has

Monty Mann

joined Glenn Advertising, Inc., as vice president in charge of the agency's Dallas office.

As vice president of Glenn Advertising, Mann will be responsible for development, planning and research. He will work with Glenn Advertising's home office in Fort Worth, Texas, and with the Los Angeles, California, branch office.

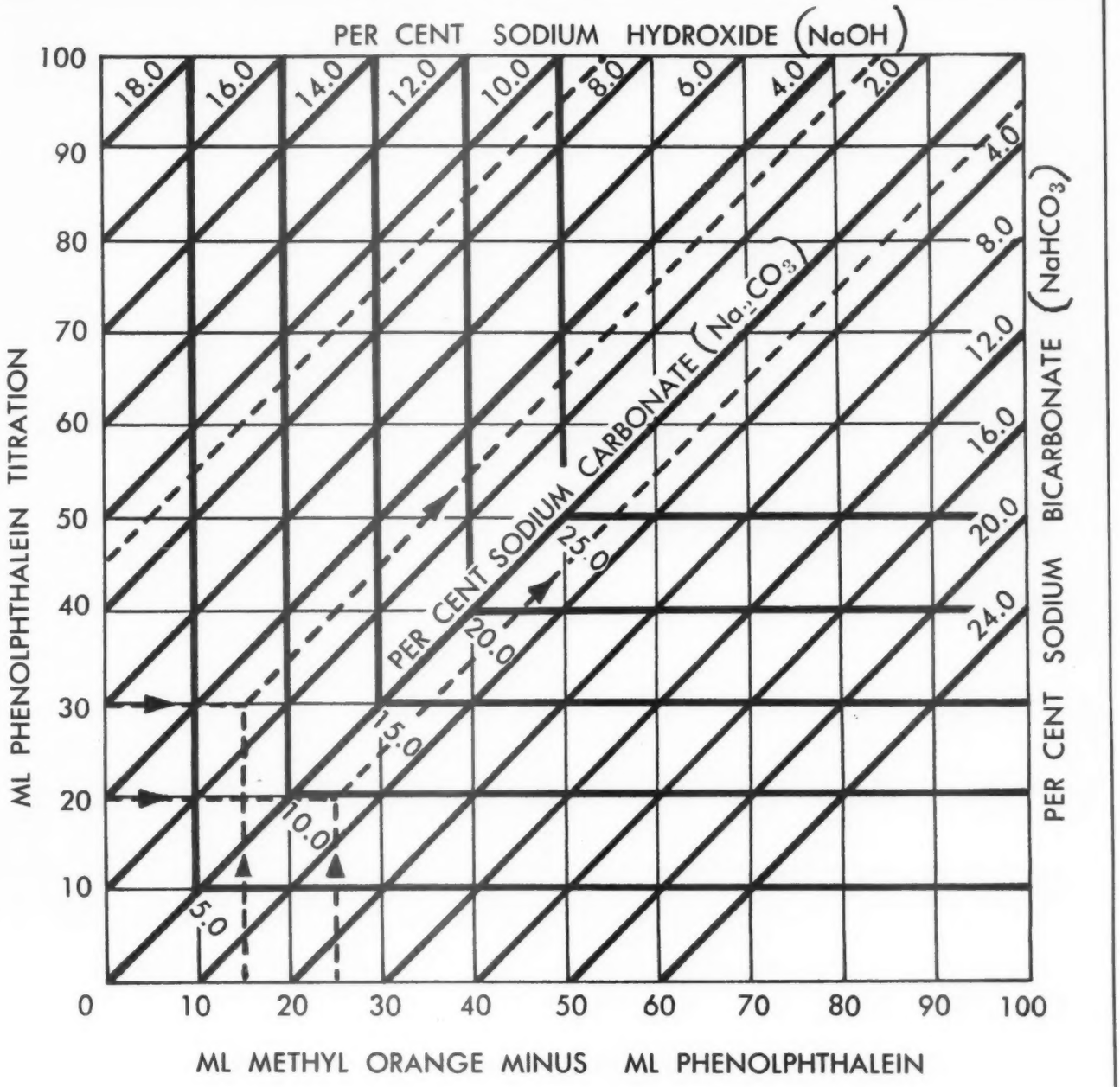
▸ **Dr. W. A. Bain,** assistant to the technical director of The Kellex Corporation, subsidiary of The M. W. Kellogg Company, and engineers in the field of nuclear energy, has been promoted to the post of director of chemical research of that company. Bain was successively a member of the faculty of North Carolina State University, and of the faculty of the University of Wisconsin.

▸ **Wade A. Eskridge** has been appointed service manager of the Twin Disc Clutch Company, Racine, Wisconsin. He was formerly assistant district manager of oilfield territory with headquarters at Tulsa, Oklahoma. The appointment was announced by N. F. Adamson, vice president in charge of engineering and sales.

A graduate of the University of Oklahoma, Eskridge joined Twin Disc in 1947.

Other appointments announced by Adamson are: **Jack N. Yetter,** district sales engineer in charge of the Tulsa, Oklahoma office, and **Harry T. Peck,** district sales engineer, operating out of the Dallas, Texas office.

TITRATION CHART FOR CAUSTIC SOLUTIONS



In plant control work, weak caustic solutions are titrated with standard acid to the phenolphthalein and methyl-orange end-points.

Calculations are usually based on the following relationships:

Acid Titre	$NaHCO_3$	Na_2CO_3	NaOH
$P < \frac{1}{2}$ M.O.	M.O. — 2P	2P	0
$P > \frac{1}{2}$ M.O.	0	2 (M-P)	2 P-M
$P = 0$	M.O.	0	0
$P = \frac{1}{2}$ M.O.	0	M.O.	0
M.O. $= 0$	0	0	P
Based on a 2 ml sample of about 1.05 gravity, the factors are:	0.404	0.255	0.192

(Using 0.1 normal acid)

For routine determinations the above calculations can be represented with sufficient accuracy by the accompanying graph. NaOH and $NaHCO_3$ percentages are found by the diagonal lines. The vertical and horizontal lines lead to Na_2CO_3.

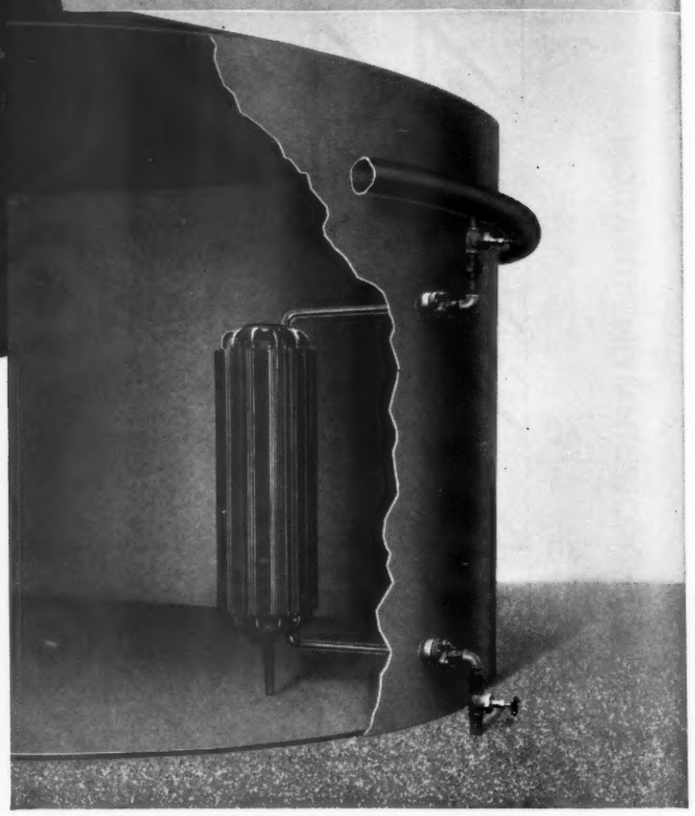
Total alkalinity as NaOH can be found on the chart by considering the entire titre to be phenolphthalein.

Examples of use: When the phenolphthalein titre is 30 ml and the methyl orange titre is 45 ml, the dotted lines show the NaOH content to be 3 per cent and the Na_2CO_3 to be 7.5 per cent. Similarly, when the phenolphthalein titre is 20 ml and the methyl orange 45 ml, the Na_2CO_3 content is seen to be 10 per cent and the $NaHCO_3$ 2 per cent. In both cases the total titre is 45 ml; hence, expressing the total alkalinity as NaOH, the chart gives 9 per cent in each case.

Courtesy of PAUL REITEMEIER, Wilshire Oil Company, Inc., Norwalk, California.

THEY'RE *New -- Better, Cheaper and More Efficient*

BROWN FINTUBE *Thermo-Flo* TANK HEATERS



● Brown Fintube **THERMO-FLO** Tank Heaters are service proved — and offer many advantages as compared to the old method of using a bare pipe coil on the bottom of the tank.

EASY INSTALLATION—THERMO-FLO heaters are compact units. They will pass through a standard 20 inch manway with ample clearance.

REDUCED FOULING—The vertical mounting practically eliminates depositing on the tubes, and avoids the necessity of heating through a layer of sediment.

EFFICIENT HEAT TRANSFER — THERMO-FLO heaters set up a thermal siphon or "flow" within the tank, resulting in highly efficient heat transfer — and avoiding stratification.

LOW VOLUME DISPLACEMENT—Due to Brown's exclusive finned tube construction, each lineal foot of fintube in the THERMO-FLO heater has the surface equivalent of 6 lineal feet of plain bare pipe.

STURDY CONSTRUCTION — THERMO-FLO heaters are built to a standard design — in low cost production quantities — and are completely assembled and tested before shipment.

INEXPENSIVE—Users report that the cost of a group of Brown Fintube THERMO-FLO heaters — plus their installation — is *less* than just the installation of a bare pipe coil having equivalent heating capacity.

EASY MAINTENANCE—THERMO-FLO heaters can be removed from the tank easily and repaired or cleaned *outside* the tank,— or a damaged heater can be replaced with another standard heater from stock.

HIGHLY FLEXIBLE—THERMO-FLO heaters can be installed in new or existing tankage and additional units can be added to meet changing conditions.

MEET ANY REQUIREMENT—THERMO-FLO heaters can be installed singly or in groups. Fabricated from mild steel, stainless steel, monel, everdur, admiralty or other metals, to meet individual conditions.

Bulletin No. 491 Gives Full Details.
Write for a copy. Today!

THE BROWN FINTUBE CO.
ELYRIA, OHIO

FINTUBE HEAT TRANSFER PRODUCTS

SELF-CONTAINED NAPHTHA POLYFORMING CORRELATION

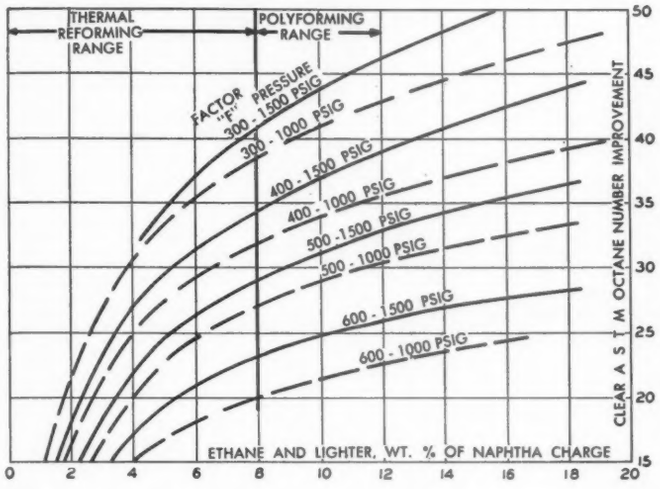

THERMAL REFORMING RANGE
POLYFORMING RANGE
FACTOR "F" PRESSURE
300 - 1500 PSIG
300 - 1000 PSIG
400 - 1500 PSIG
400 - 1000 PSIG
500 - 1500 PSIG
500 - 1000 PSIG
600 - 1500 PSIG
600 - 1000 PSIG
CLEAR A S T M OCTANE NUMBER IMPROVEMENT
ETHANE AND LIGHTER, WT. % OF NAPHTHA CHARGE

FIG. 4. Octane number improvements from thermal treatments of naphthas.

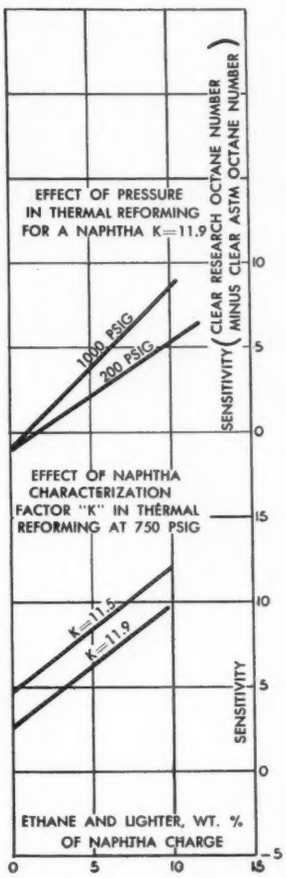

EFFECT OF PRESSURE IN THERMAL REFORMING FOR A NAPHTHA K=11.9
1000 PSIG
200 PSIG
SENSITIVITY (CLEAR RESEARCH OCTANE NUMBER MINUS CLEAR ASTM OCTANE NUMBER)
EFFECT OF NAPHTHA CHARACTERIZATION FACTOR "K" IN THERMAL REFORMING AT 750 PSIG
K=11.5
K=11.9
SENSITIVITY
ETHANE AND LIGHTER, WT. % OF NAPHTHA CHARGE

FIG. 5. Right, variation of sensitivity in thermal reforming.

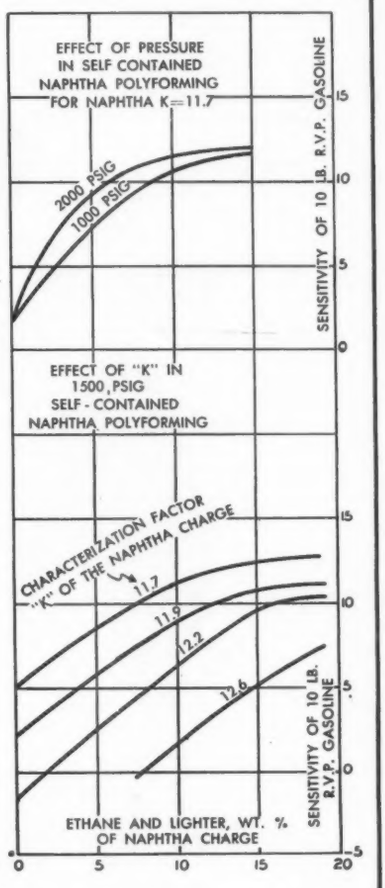

EFFECT OF PRESSURE IN SELF CONTAINED NAPHTHA POLYFORMING FOR NAPHTHA K=11.7
2000 PSIG
1000 PSIG
SENSITIVITY OF 10 LB. R.V.P. GASOLINE
EFFECT OF "K" IN 1500, PSIG SELF-CONTAINED NAPHTHA POLYFORMING
CHARACTERIZATION FACTOR "K" OF THE NAPHTHA CHARGE
11.7
11.9
12.2
12.6
SENSITIVITY OF 10 LB. R.V.P. GASOLINE
ETHANE AND LIGHTER, WT. % OF NAPHTHA CHARGE

Fig. 6. Far right, variation of sensitivity in self-contained naphtha polyforming.

▸ Relationship of octane number improvement to severity factor. In self-contained naphtha polyforming, the clear ASTM octane number improvement is a function of the pressure, the characterization factor of the naphtha charge, the charge octane number, and the severity factor. Fig. 4 shows the octane number improvements at 1500 psig, and 1000 psig. These figures were drawn from data similar to that used for Fig. 3. Octane numbers of the naphtha charges are not sufficient by themselves to correlate with the octane number improvements. When the charge octane number is multiplied by the characterization factor of the charge, the product "F" is a factor against which octane number improvement may be correlated, when the effects of pressure and severity factor are taken into account.

Data for 2000 psig and 500 psig are available but are not included here since the optimum operating pressure is in the region shown.

From Fig. 4, the octane number improvements for thermal naphtha reforming and self-contained naphtha polyforming may be estimated. In general, thermal naphtha reforming is conducted at smaller severity factors than self-contained naphtha polyforming, and the octane number improvement by the two processes join in a smooth curve. From Fig. 4, it may be concluded that the size of the incremental octane number improvement obtained in self-contained naphtha polyforming depends upon the severity factor.

▸ Variation of sensitivity with severity factor. In the thermal reforming of naphthas, the sensitivity (clear Research octane number minus clear ASTM octane number) of the gasoline produced increases with increasing pressure and with increasing severity factor. The sensitivity of the gasoline produced from a naphtha charge stock with a low characterization factor is larger than the sensitivity of the gasoline produced from a naphtha charge stock with a high characterization factor. These facts are shown in Fig. 5. The magnitude of the sensitivity of the gasoline produced varies probably with the magnitude of the sensitivity of the charge naphtha.

In self-contained naphtha polyforming, the sensitivity of the gasoline produced follows the same trends as in thermal reforming. That is, a low naphtha charge characterization factor, a high pressure and severe cracking tend to produce a large sensitivity in the finished gasoline as shown in Fig. 6. The upper half of Fig. 6 shows the effect of increasing pressure on the sensitivity of the gasoline produced. The bottom half of Fig. 6 shows the effect of characterization factor and severity factor of 1500 psig for self-contained naphtha polyforming. The sensitivity approaches a maximum value which is greater than that obtainable in thermal reforming, simply because the presence of the diluent gases permits a greater severity factor in polyforming than in thermal reforming. Beyond a certain severity factor it does not appear desirable to polyform for increased sensitivity of the finished gasoline since the curves tend to level off, especially for stocks with low characterization factors. However, the maximum sensitivity is usually above that obtained in thermal reforming and it may be achieved at shallow depths of cracking at high operating pressures.

Taken from the exclusive article of the same title, by W. A. Goldtrap and E. L. Jones, published in *The Petroleum Engineer*, October, 1948, pages 269 to 272, inclusive.

How George and Jean won $2,000 college scholarships

These two young Westerners, Jean Hathaway of Chico, California, and George Emde, Jr. of Lodi, California, will begin college next fall with the help of $2,000 scholarships awarded by Standard of California.

They were chosen as outstanding among 4-H Club and Future Farmers of America members who raised and showed their own livestock at the recent Grand National Junior Livestock Exposition in San Francisco. Four other scholarships of $1,000 each were also awarded–to Mary Lee Hay of Lovelock, Nevada; Robert Young of Quincy, California; Ralph Boyd of Lancaster, California; and James Buell of Buellton, California.

Scholastic ability, leadership, personality, records in club projects were all considered by 4-H Club and F. F. A. judges.

We'd like to say "Good Luck!" to George, Jean, Mary, Robert, Ralph and James. We know they'll do a fine job in school...and later as good citizens of the West.

STANDARD
OF CALIFORNIA
plans ahead to serve you better

Standard Oil Company of California

METHODS USED IN ESTIMATING NATURAL GAS RESERVES

● **Methods of estimating non-associated gas reserves.** *Volumetric method.* This method, as currently used, makes use of structural and isopachous maps based on data from electrical logs, cores, and drillstem and production tests. Sand volumes are obtained by planimetering. Core analysis data and electrical log interpretation permit reasonable estimates of porosity, connate water, and net productive thickness so that the volume of gas filled pore space may be calculated. Laboratory analysis of the gas for determination of its compressibility at various pressures and temperatures, and the determination of reservoir pressure and temperature by recording instruments make it possible to calculate the volume of gas contained in the reservoir with reasonable accuracy.

Calculation of the gas in place in the reservoir may be accomplished by use of the following formula:

$$Q = 43{,}560 \times \phi \times (1 - Sw) \times \frac{P}{P_b} \times \frac{460 + t_b}{460 + t} \times \frac{1}{Z}$$

Where:

- Q = cu ft of gas per acre-ft at base temperature and pressure,
- 43,560 = number of cu ft per acre-ft,
- ϕ = porosity expressed as a decimal fraction,
- Sw = interstitial water expressed as a decimal fraction,
- P = reservoir pressure, psia,
- P_b = base pressure, psia,
- t = reservoir temperature, F,
- t_b = base temperature, F,
- Z = compressibility factor at pressure P.

Reserves may also be calculated volumetrically by use of the pound mol as a base for computation. The following formula is used:

$$V = \frac{ZNRT}{P}$$

Where:

- V = volume in cu ft,
- Z = compressibility factor at pressure P,
- N = number of pound mols,
- R = 10.71,
- T = absolute temperature,
- P = pressure, psia.

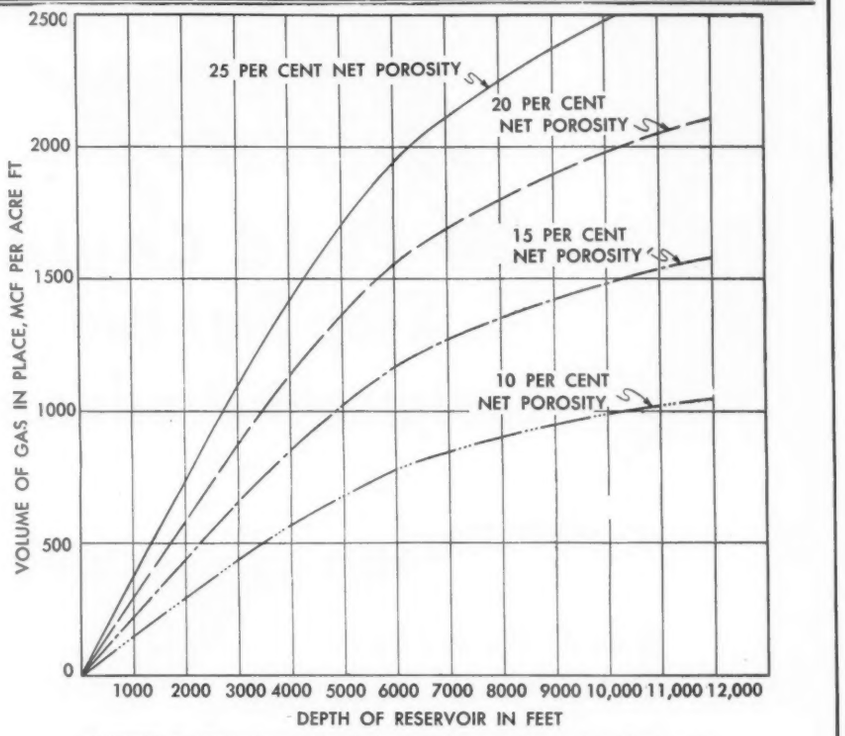
The volume occupied by one pound mol of any gas at standard conditions is 379.4 cu ft. Therefore, the volumetric formula may be expressed as follows:

$$Q = 43{,}560 \times \phi \times (1 - Sw) \times \frac{379.4}{V}$$

Where:

- V = cu ft of gas per pound mol at reservoir conditions.

In the event a water drive is not anticipated the volume of gas that will remain in the reservoir at the expected abandonment pressure may be calculated, and deducted from the volume of gas initially in place to determine the volume of recoverable gas.


25 PER CENT NET POROSITY
20 PER CENT NET POROSITY
15 PER CENT NET POROSITY
10 PER CENT NET POROSITY
VOLUME OF GAS IN PLACE, MCF PER ACRE FT
2500
2000
1500
1000
500
0
1000 2000 3000 4000 5000 6000 7000 8000 9000 10,000 11,000 12,000
DEPTH OF RESERVOIR IN FEET

CURVE 2. Relation of original volume of gas in place per acre foot to depth of reservoir for various net porosities.
BASE PRESSURE—14.65 PSI. WET GAS GRAVITY—.678.
SEPARATOR YIELD—20 BBL PER 1,000,000 CU FT GAS

Water advancement rate is a function of the area of the gas-water contact, the permeability of the reservoir, and the pressure differential created by gas withdrawals. Recoverable gas is usually estimated for water drive reservoirs by applying a recovery factor to the calculated volume in place. The selection of a recovery factor depends on the thickness and homogeneity of the sand, the relative permeability of the sand to gas and water at varying gas saturations, the per cent of the gas-containing portion of the reservoir originally underlaid by water, the dip of the reservoir beds, and the amount of structural closure above the gas-water contact.

The volume of gas in place per acre-foot may be computed at any stage of depletion at which the reservoir pressure is known. If the volume of gas that has been withdrawn from the reservoir is also known, the following formula may be used to determine the volume of the reservoir if a water drive is not operative.

$$A = \frac{C}{Q_o - Q}$$; where:

- A = acre ft of gas pay,
- C = cumulative gas production in cu ft to reservoir pressure P,
- Q_o = cu ft of gas initially in place per acre-ft,
- Q = cu ft of gas in place per acre-ft at the reservoir pressure P.

If this calculation is made at various reservoir pressures and the reservoir volume is indicated to be the same by each calculation, the absence of water drive is indicated.

In the event that water is encroaching into the reservoir this calculation will result in an apparent increase in the number of acre-feet in the reservoir at each successive time. When this condition is encountered it is necessary to rely solely on geologic data to determine the reservoir volume. Successively larger reservoir volumes might also be calculated in the case of gas fields where water drive is absent if only a small portion of the reservoir is developed and shut-in pressures measured in the wells are considerably below the true pressure of the reservoir.

Porosity is the most important factor in the volumetric formula and a small error in porosity will result in a large error in the estimated reserve. For instance, if the porosity is actually 20 per cent and is estimated to be 15 per cent the result is a reserve estimate that is 25 per cent low. (Curve 2 shows the relationship of the original volume of gas in place to the depth of the reservoir for various net porosities).

Taken from the article, "A Critical Review of Methods Used in the Estimation of Natural Gas Reserves," by Henry J. Gruy and Jack A. Crichton of DeGolyer and MacNaughton, presented before the Tulsa, Oklahoma, and Los Angeles, California, meetings of the Petroleum Division, American Institute of Mining and Metallurgical Engineers, October 8-10 and 23-24, 1947, respectively, and published in *The Petroleum Engineer*, October, 1948, pages 208 to 220 inclusive.

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DESIGN OF A VAPOR SAVING SYSTEM

The principal steps in the design of a vapor-saving system using a lifter roof tank* are: (1) determine which of the tanks to equip with a lifter roof and the height of the lift to provide the required capacity, (2) lay out and compute the correct diameters of the vapor lines and (3) specify vents, gauges, and other fittings for the tanks in the system. The data and formulae in the 5 sheets of this study provide a basis for designing such a system for any given combination of assumed conditions.

DETERMINING THE CAPACITY

A storage tank of lifter roof design* should have sufficient capacity to hold all of the vapor displaced from the tanks and piping by thermal breathing under average operating conditions. In addition to this a reasonable allowance for unbalanced pumping may be included. If the storage tanks in the vapor-saving system are, on the average, half full, the lifter roof tank should be designed to hold the air-vapor mixture displaced by breathing from half full tanks. If the tanks average one-third full, breathing should be figured on two-thirds of the tank capacity.

The breathing requirement is based on the following relation:

$$(1)\quad I = 100\left[\left(\frac{\triangle - p}{A+\phi-P}\right)\left(\frac{T+460}{t+460}\right) - 1\right]$$

I = per cent volume increase of vapor space,

$\triangle$ = absolute tank pressure at which vacuum vent opens, psi,

A = atmospheric pressure, psi,

ϕ = gauge tank pressure at which pressure vent opens, psi,

p = vapor pressure at minimum liquid surface temperature, psi,

P = vapor pressure at maximum liquid surface temperature, psi,

t = minimum average vapor space temperature, degrees Fahrenheit.

T = maximum average vapor space temperature, degrees Fahrenheit.

For simplicity the above formula may be written with practical accuracy as shown in Equation (2):

*Horton Lifter Roof.

FIG. 1. Typical vapor saving system.

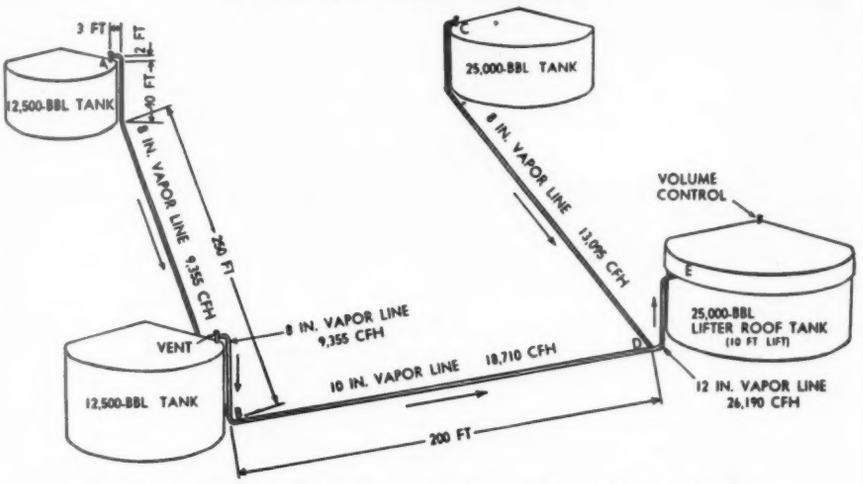

TABLE 1. Pressure drop in vapor lines—from Fig. 2, Sheet 5.

Section of Vapor Line	Vapor Flow CFH	Assumed Pipe Diam, In.	Equivalent Length in Ft	Press. Drop Per 100 Ft, In. H_2O	Total Pressure Drop, In. H_2O	
					AE	CE
AB	9,355	8	411	.084	.35	
BD	18,710	10	275	.110	.30	
CD	13,095	8	411	.165		.68
DE	26,190	12	233	.087	.20	.20
Total Pressure Drop—Section AE					.85	
Total Pressure Drop—Section CE						.88

Equivalent lengths of vapor line sections.

Section of Vapor Line		AB-8 In. Diam		BD-10 In. Diam		CD-8 In. Diam		DE-12 In. Diam	
Kind of Loss	Diam	No.	Ft	No.	Ft	No.	Ft	No.	Ft
Entrance	25	1	16			1	16		
90° Elbow	30	2	40			2	40	2	60
Tee	90	1	60	1	75	1	60	1	90
Exit	40							1	40
Actual Length of Section			295		200		295		43
Total Equivalent Length			411		275		411		233

$$(2)\quad I = 100\left(\frac{P-p}{14.7-P}\right) + 100\left(\frac{T-t}{500}\right) - 100\left(\frac{0.036R}{14.7-P}\right)$$

R = Range of operating pressure, inches of water (including the entire difference between the pressure setting and the vacuum setting of the relief vents), and

$0.036R = A+\phi-\triangle$ = range of operating pressure, psi.

The first term, $100\left(\frac{P-p}{14.7-P}\right)$, is the breathing resulting from increase in liquid surface temperature. The value of this term is obtained from Table 2 (Sheet 2).

The second term, $100\left(\frac{T-t}{500}\right)$, is the breathing resulting from temperature increase of the air-vapor mixture. Its value appears in Table 3 (Sheet 2).

The third term, $100\left(\frac{0.036R}{14.7-P}\right)$, is a reduction resulting from the helpful effect of the maximum and minimum operating pressures (pressure and vacuum). For example, if the pressure vent setting is 5 in. of water and the vacuum vent setting is ¾ in. of water, the total operating range is then 5¾ in. of water. The value of this term is read from Table 4 (Sheet 3). It is always subtracted from the sum of the first two terms.

Equation (2) and Tables 2, 3, and 4, which solve Equation (2), are sufficiently accurate for typical motor gasolines with the normal range of atmospheric temperatures. For other liquids and for abnormal temperature conditions, Equation (1) should be used.

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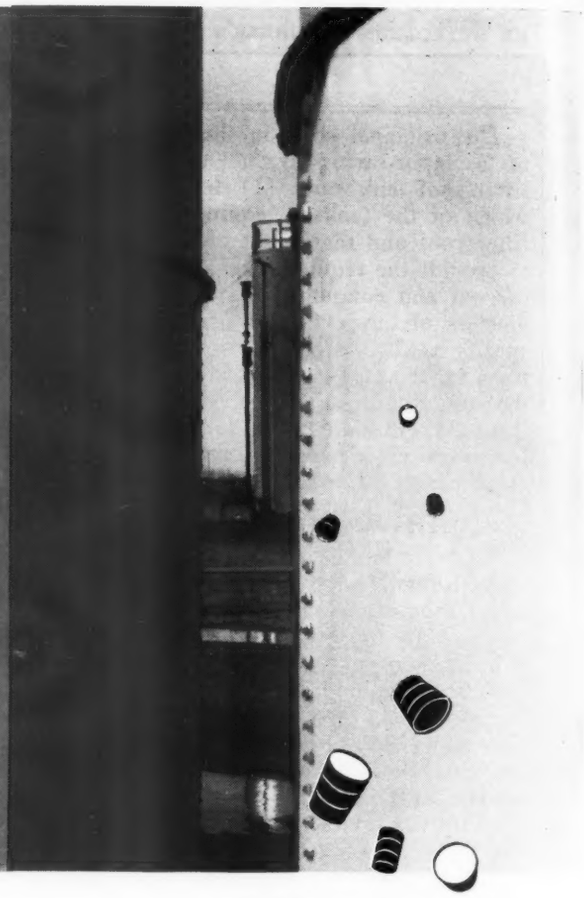

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(1) D-C Motors Available

General Electric standard totally enclosed, unit-cooled d-c motors in ratings up to 200 hp now are available with a new type cooling assembly that enables them to operate at slow speeds for long periods of time, the company's large motor and generator divisions has announced.

Two blowers, driven by a single Tri-Clad induction motor, in the air-to-air cooling assembly provide ventilation independent of motor speed. One blower circulates internal air through the motor and unit cooler, while the other blows external air through the cooler. The new cooling sytem makes full torque possible down to almost zero speed continuously.

(2) Norma Grease

The Norma-Hoffmann Bearings Corporation, Stamford, Connecticut, announces that its Norma G-66 "stability-tested" grease is now available to users for bearing lubrication. This ball and roller bearing grease was originally developed for use in Norma-Hoffmann ball and roller bearings to provide a stable, thoroughly clean lubricant, of suitable composition and consistency to provide lubrication over a wide temperature range without separation, drying out or hardening.

This compounded grease is highly resistant to oxidation in storage as well as in service. It is insoluble in water and will not emulsify or aerate in the presence of condensed moisture.

Norma "stability-tested" grease is offered to the bearings user for lubricating grease-packed bearings as well as unsealed bearings. It is supplied in tubes for convenient servicing of bearings in the plant and field, and in larger containers where greater quantities of grease are required.

(3) Tank Heaters

The Brown Fintube Company, Elyria, Ohio, announces the production of a new Thermo-Flo tank heater. The heater will pass through a standard 20-in. manway with ample clearance.

The vertical mounting practically eliminates depositing on the tubes, and avoids the necessity of heating through a layer of sediment, according to the manufacturer. Also, the heaters can be removed from the tank easily and repaired or cleaned outside the tank, or a damaged heater can be replaced with another standard heater from stock.

New or existing tankage and additional units can be added to meet changing conditions.

(4) Swivel Hook

Superior Oil Tool Company, Santa Fe Springs, California, announces a new cable-tool swivel hook. The tool is made of forged steel, is 28 in. long from the center of the clevis pin to the hook, and has a ball bearing swivel. The capacity is 30 tons. The extremely short and compact design saves space in handling pipe and casing. A wide center permits straighter in-line pull from links to elevators and the use of short elevator links. Adaptation can be made to any size block by changing swivel links.

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51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66		

NAME..... TITLE.....

COMPANY NAME.....

STREET ADDRESS.....

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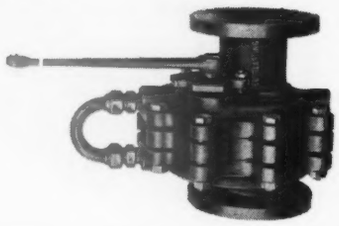
(5) Steam Jacketed Valve

For the transmission of viscous materials which congeal or harden and will not flow at ordinary temperatures, Everlasting Valve Company has developed a steam jacketed valve. In these valves, the disc slides across the ports in a rotating self-clearing action actuated by a quick operating lever. When wide open, the valve offers straight through flow with unrestricted passage. All parts move in a parallel plane so that the mechanism is non-wedging.



Ample jacket space surrounds the port openings as well as the body, providing extensive heating surface and correct temperature to insure fluidity of the materials being handled. The steam or other heating medium can be connected to the jacket at either side of the valve. Expansion and contraction due to changes in temperature do not affect the operation or leak-proof qualities of the valve. These valves are available in 2-in., 3-in., and 4-in. sizes, for 125 psi line pressure and 125 psi jacket pressure.

(6) Shut-Off Valve

Tork-Master Company, Inc., announces the development of its Mac Bain positive shut-off valve. The valve is engineered to high quality standards with low maintenance cost one of its major features, according to the manufacturer. Basically it is a check valve with main and primary seats and disks, worm and gear driven to provide positive control in opening and closing. Torque thus applied enables the valve to open easily against rated pressures with manual control in closing.

Many months of testing in permanent installations have proved the valve highly satisfactory. Installed to handle butane and other LPG products, it has given good results, the maker states. Gasoline, diesel oil, stove oil, fuel oil, hot wax, and alkane are equally well handled, particularly on tank car loading racks.

Valves are available from warehouse stocks in 2-in., 3-in., and 4-in. sizes for pressures of 150 and 300 psi. For more complete details and list prices write Tork-Master Company, Inc., 1624 Seabright Avenue, Long Beach 13, California.

(7) Centrifugal Pumps

A wide expansion in its line of self-priming centrifugal pumps has been announced by Marlow Pumps, Ridgewood, New Jersey. The recently amplified line contains 26 basic series of pumps, which in turn are available in virtually endless modifications and combinations of mountings, fittings, and materials.

Included in the new line are electric horizontal long-coupled and vertical and horizontal close-coupled models, portable and stationary engine-driven models and belt-driven models. All pumps in the line feature Marlow's free-flow design and the exclusive "diffuser" method of priming in which the design of the pump itself enables it to prime automatically. The pump contains no by-pass valves or other mechanical devices. They will pump liquids with viscosities up to 500 S.S.U.

The motor powered long-coupled (Type EL) models in the line cover sizes, capacities, and head ranges of 1½ to 10 in., 15 to 3500 gpm and 15 to 170 ft, respectively. These pumps are standard in cast iron or welded steel and many are available in other metals for special requirements. Many models are made with either flanged or screwed suction and discharge connection. Motors are from ½ to 60 hp and are mounted with the pump on welded steel frame, or on wheel mounting where portability is desired.

Many of the motor-driven models in capacity range from 50 to 250 gpm are available in close-coupled construction. The manufacturer calls these pumps Type EC.

Three Type EV vertical models are part of this new industrial line. These are electrically driven with the motor close-couple-mounted directly over the pump, a design developed especially for installations where floor space is limited. The capacities range from 5 to 70 gpm; heads from 15 to 47 ft. Motors are explosion-proof, repulsion induction type, single-phase, in ⅓ to ½ and ¾ hp.

The 1949 line also carries self-priming centrifugals in pump end only or fitted for V-belt drive, Type EB. In both high- and low-pressure models they offer the same pumping features as the other models. Size range is from 1½ to 10 in., capacities from 15 to 3500 gpm, heads from 15 to 250 ft.

In addition to motor-driven models, the entire line of Marlow self-priming centrifugal pumps for industry is available with engine drive. Low-pressure sizes, 1½ to 10 in., capacities from 50 to 4000 gpm. High-pressure models from 2 to 6 in., capacities 50 to 1000 gpm. Gasoline or diesel engine powered.

(8) Propane Cylinders

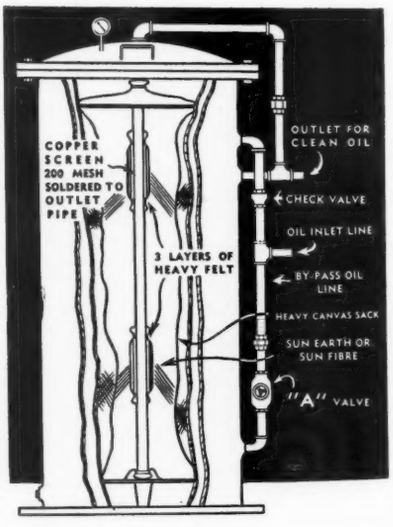
Mass production of a new lightweight, high-strength propane cylinder of 100-lb capacity and tare weight of only 72 lb has been announced by Harrisburg Steel Corporation, Harrisburg, Pennsylvania.

The cylinders have been given the trade name "Lite-Weight" and are made of a special high tensile strength alloy steel to ICC specification 4BA-240. Cylinders are supplied in any quantity desired, with or without pressed steel caps, with valve inserted if the customer desires.

Advantages claimed are: Less weight on trucks when transporting; easier moving in, out, and around warehouses and filling plants; superior corrosion resistance; easier sliding on and off trucks due to smooth-side construction, and uniform thickness throughout.

(9) Dual-Flow Oil Filter

The Sun dual-flow oil filter now has improved design for still greater efficiency. As shown in the drawing, the new by-pass oil line accommodates simultaneous flow through the engine by use of relief valve and outside flow chamber, and therefore does not build up a high pressure. The multishell construction permits heating the filter element by circulation of engine discharge oil which cools on leaving the annulus and before reentering the



crack case. The filter uses fullers earth as a meduim. In addition to this oil filter, the Sun Engineering Company also manufactures Sun Diesel Fuel Filters for use on diesel engines of any horsepower rating, and for either stationary or rolling stock. This fuel filter assures a constant flow of clean fuel; preheats fuel for greater efficiency and therefore reduces maintenance expense as well as increasing engine efficiency.

Arc Welding of Pumps Cuts Weight 56%

By E. L. Alexander, Chief Engineer
George E. Failing Supply Company
Enid, Oklahoma

THROUGH the use of arc welded construction, the weight of our pump unit has been reduced from 1,475 pounds to 650 pounds. This saving of 825 pounds is important since the drilling unit on which the pump is used must be highly mobile. The drills are used for oil exploration work and for water well drilling. The pumps are designed for operation at 375 psi. The arc welded construction has eliminated sand holes, surface blemishes, and uneven metal distribution in cast parts. A recent cost analysis indicates the pumps will be produced at a saving.

The development of our all welded pump is typical of the general trend in the oil industry toward all welded machines and equipment. As a result of the greater durability to withstand severe service, many customers show a decided preference for arc welded steel construction.

Important to us also is the freedom for future design improvements and further cost reductions possible with arc welded construction. By discarding patterns and castings, we eliminate many of the cost restrictions that would otherwise limit progressive design changes in our products.

Fig. 1. Saves 825 pounds *by using welded steel construction on mud slush pump. Simple fixture is used to position parts with close fit-up for speedy welding.*

Component parts for our welded pumps are fabricated from flame-cut mild steel plate and from SAE 1020 cold drawn tubing. The two main units are the mud end shown in Fig. 2 and the power end shown in Fig. 3. These units are first fabricated as sub-assemblies in separate jigs and then arc welded in master jigs with "Fleetweld 5" electrode, using Lincoln "Shield-Arc" welders.

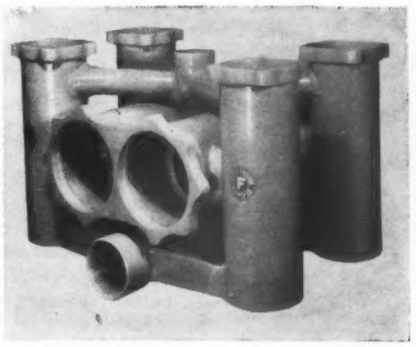


Fig. 2. Mud End Assembly. *Parts are fabricated from SAE 1020 cold drawn steel tubing with 3/16" wall thickness; flanges are flame-cut from 1/8" plate. Welds are 1/4" or 3/8", single and multiple pass, depending on the joint preparation.*

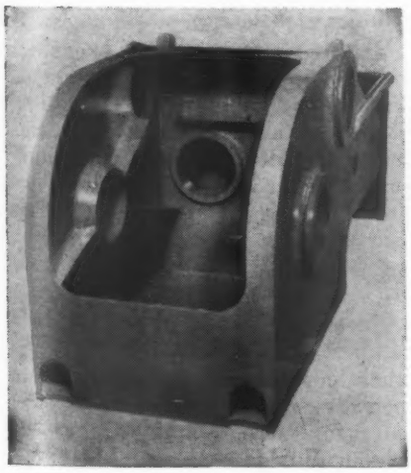


Fig. 3. Power End Housing. *Walls are flame-cut from 3/16" steel plate. Bosses are machined from steel tubing and fillet welded to wall with 1/8" "Fleetweld 5" electrode.*

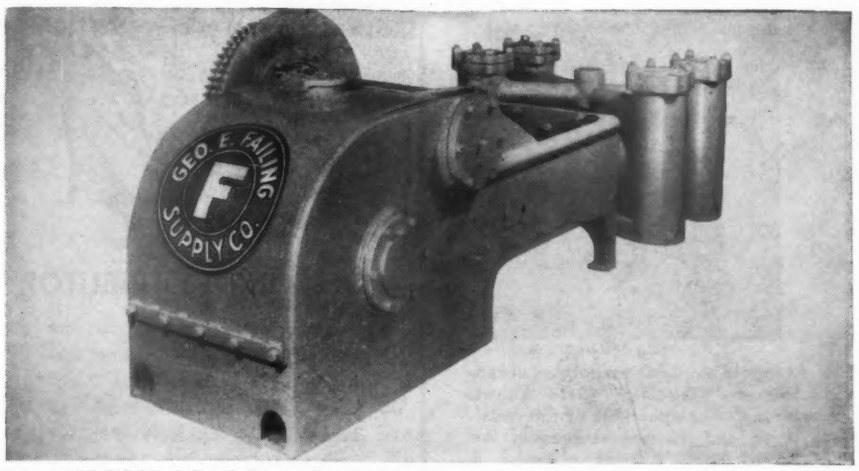


Fig. 4. All Welded Steel Pump *for well drilling operations. Light in weight and easy to move around . . . has corners rounded for "modern" appearance.*

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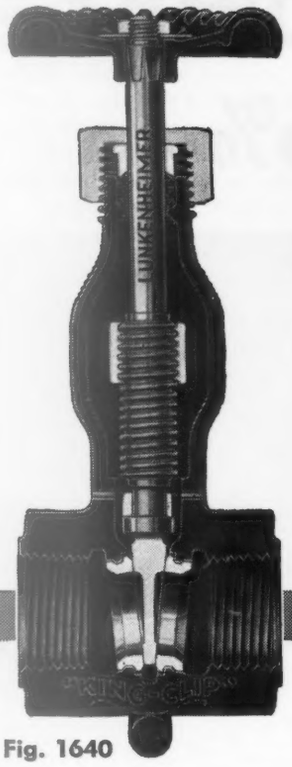

YOUR VALVE DOLLAR
Goes Farther—
with LUNKENHEIMER "KING-CLIP" VALVE

Fig. 1640

The Lunkenheimer "King-Clip" Valve has one quality feature after another... from the coarse, heavy stuffing box threads and hex-head gland which minimize stuffing box troubles... to the heavy body which resists wrenching and piping strains... and the heavy rust-proofing treatment, inside and out. Each feature adds longer life, lower maintenance and better service, wherever small and medium sized gate valves are used.

Note the ample, unobstructed drain channels and bronze thread bushing, features originated by Lunkenheimer, as was the "King-Clip" Valve itself. The Lunkenheimer "King-Clip" Valve is truly the king of all clip type valves... widely used for more than 50 years and, today, better than ever for longer, low-cost service.

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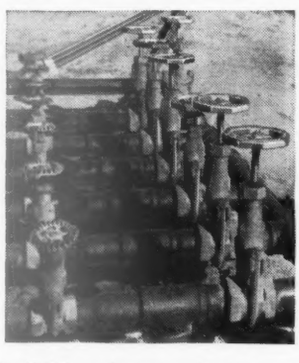


Manifold employing multiple Lunkenheimer "King-Clip" Gate Valves. Note the compactness of the installation and the convenience of the bolted bonnets, each of which is readily accessible. "King-Clip" Gate Valves are furnished in 21 standard types, with iron body-bronze trim, all-iron or iron body-alloy trims and with inside or outside rising stems for various service needs.

ASK YOUR DISTRIBUTOR

Consult your valve specialist, the friendly near-by Lunkenheimer Distributor. He has a stock of "King-Clip" Valves as well as other fine Lunkenheimer products. Ask for Bulletin 561 which details the 21 standard types of "King-Clip" Valves.

(10) Jackhamer

A new, medium-weight Jackhamer has been introduced by Ingersoll-Rand Company. Known as the J-40 Jackhamer, the new machine is similar in design to the heavier J-50 model and contains many of its known features.

Powerful blows, strong rotation of drill steel, and plenty of hole-cleaning ability result in faster drilling speeds for the J-40, it is asserted. A double-kicker port valve permits full air pressure on the piston for a longer period

of time, giving more powerful blows and much stronger rotation. A specially designed auxiliary port allows full line air pressure to pass through the drill steel when the blower valve is opened, giving a strong blowing action. The design of the throttle valve and the air-supply port permits the gradual admittance of air into the cylinder.

A three-in-one backhead enables the machine to be quickly adjusted for wet, dry, or blower-type drilling.

For additional information on this new tool write Ingersoll-Rand Company, 11 Broadway, New York 4, New York, or any of its branch offices throughout the world.

(11) Steel Valve

Ansul Chemical Company, Marinette, Wisconsin, has developed another engineering aid. This is a specially-designed, all-stainless steel valve for mixing liquid or gaseous sulphur dioxide, and water. It is suitable for any application where a continuous supply of an SO_2-water mixture is desired. With proper auxiliary equipment, specific concentrations are easily maintained. The flow of sulphur dioxide into the valve is accurately regulated by the valve control handle.

Water inlet and outlet on this No. 317 stainless steel valve are standard 1-in. pipe thread. The sulphur dioxide inlet is ¼-in. pipe thread.

(12) Bridging Plug

A new, one-piece, ductile aluminum alloy, expansion type bridging plug, that features simplicity, positive action, greater pipe clearance and a 90 minute or less drilling out speed, has been announced by McCullough Tool Company, Los Angeles, California.

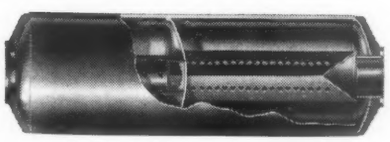
By eliminating rubber packers the new bridging plug gains greater pipe clearance, allowing it to go in the hole that much faster. Elimination of rubber, springs, cast iron, steel rings and slips facilitates drilling out, as loose parts tend to rotate under the bit in ordinary plugs, according to the manufacturer.

A diamond point bit on a string of tubing will eliminate one of these plugs in 60 to 90 minutes. The ductile aluminum alloy plug expands, when the powder charge is fired, and forces itself against the pipe—tight enough to hold extremely high pressures and also tight enough to hold itself against rotation until it is drilled out.

The new plug has been designated the McCullough Type "B" Bridging Plug. The Type "B" plug is available for 4½-in., 4¾-in., 5-in., 5½-in., 5¾-in., 6⅝-in., 7-in., and 8⅝-in. O.D. casing. For further information write to the McCullough Tool Company, 5820 South Alameda Street, Los Angeles 11, California.

(13) Slug Buster Snubber

Burgess-Manning Company, Libertyville, Illinois, has announced a new line of snubbers designed to reduce noise from engine exhausts and vacuum pump discharges to the noise-level of the surrounding industrial area. It is intended for applications in the petroleum, chemical, and industrial fields. This snubber is a heavy-duty unit, sturdily constructed, portable. A heavy, double shell, internal reinforcements, and flanged, dome-type heads provide added support and strength. Heavy gussets at each end of the snubber help maintain proper alignment. Designated as Series SDG, these units are available in pipe sizes from 5 to 24 in., inclusive.



New Thermoid TRIOFLEX Wire Braid Hose

Thermoid's Answer to an Insistent Demand for a Light Extremely Flexible Hose for Oil Field Service

Another exclusive quality product by the makers of Powerflex Rotary Hose

1 High tensile neoprene cover for protection against abrasion and weather.

2 Braided steel wire reinforcement for lighter weight, with maximum strength.

3 Neoprene tube to resist abrasion and deteriorating effects of oil.

Can be coiled in 36″ coil.

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Furnished in 2″ and 2½″ sizes, in lengths from 30 to 50 feet. Coupled with Boss Male Couplings.

Each length tested to 1000 lbs. before shipment.

Prompt shipment from your nearest supply store.

Thermoid Quality Products: Oil Country Flat Belting • Wire Line Turn Backs • No-Wip Line Savers • Stuffing Box Rings • All types of Hose • Molded Special ties • Powerflex Rotary Hose • Mud-Flo Slush Pump Hose • Flexible Discharge Units • Brake Blocks • F.H.P. and Multiple V-Belts

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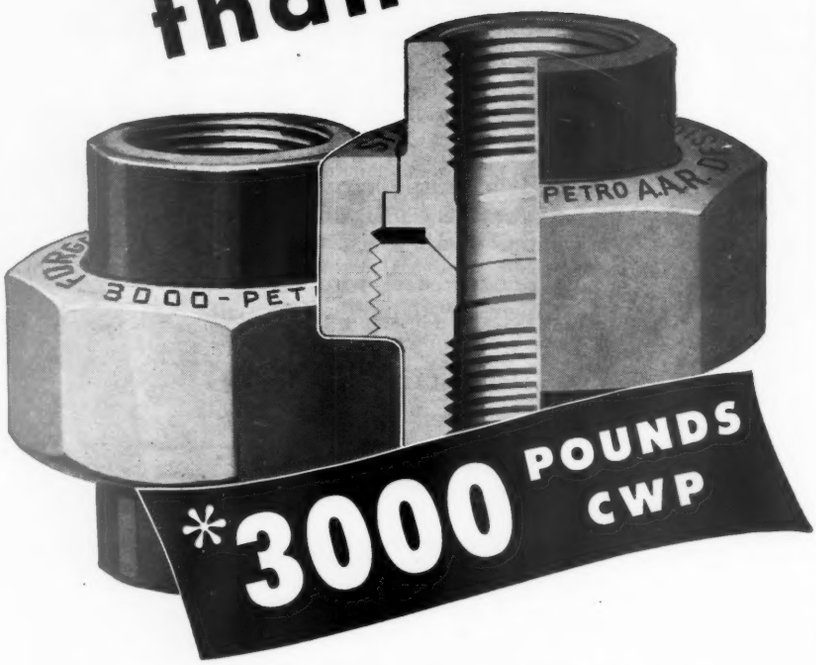

New—modern equipment developed under war time service and experience is being utilized in producing our line of Forged Steel Unions. Increased physical strength, finer grain structure of these scale free precision forgings now permit increased ratings of "*Petro*" to 3000# CWP and "*Handle Bar*" to 4000# CWP — without dimensional changes.

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ORDER BY TRADE NAME FROM YOUR LOCAL JOBBER

ORIGINATORS AND PIONEERS OF STEEL UNIONS SINCE 1912

CLAYTON MARK & COMPANY

1900 DEMPSTER STREET • EVANSTON, ILLINOIS

(14) Fire Extinguisher

A brand new Dry Chemical type fire extinguisher has just been announced by American-LaFrance-Foamite Corporation. According to claims of the manufacturer, it has many new outstanding advantages such as longer range, longer duration of discharge, more complete discharge

of the dry chemical contents, gas-tight, all-internal expelling gas connections, built-in safety disc, and is lighter in weight.

The dry chemical is nontoxic, noncorrosive, nonconductor of electricity, and will not freeze. It is a hand portable unit identified as No. 30 Alfco Dry Chemical.

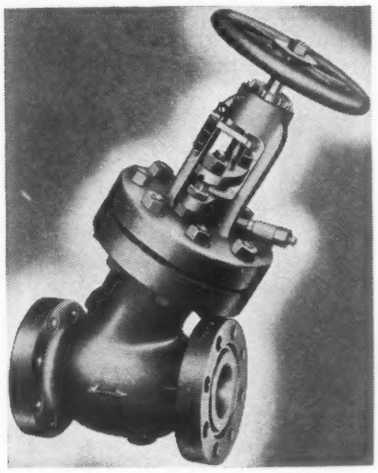
(15) Glass Pipe Wrap

Officials of Midwestern Engine and Equipment Company, Inc., Tulsa, Oklahoma, exclusive national distributor for Owens-Corning Fiberglas underground pipewrap, recently announced a new type of fibrous glass underground pipe wrap, developed and manufactured by Owens-Corning, called coromat. The new material is the product of research and development in increasing tensile strength, tear strength, and porosity in pipe wrap mat, it is stated.

The new fiberglas coromat is a porous mat of glass fibers reinforced with long, continuous strands of fiberglas yarn, which are added during the forming process to become an integral part of the pipe wrap. By incorporating them in a multi-directional pattern in the Coromat, its tear strength has been increased upward to 400 per cent and the tensile strength is many times greater than the fiberglas pipe wrap previously manufactured, and is sufficient to allow the manufacturing of 1200-ft rolls for standard field application, whereas, previous materials have been normally of 400-ft or 800-ft lengths.

(16) Positive Shut-Off Valve

Hot acids, strong or highly corrosive solutions, hydrocarbons and other penetrative fluids can now be handled with assurance of tight shut-off despite corrosive action or deposits on the valve parts, according to the Sellers Injector Corporation, which announces a new valve for such services. Features include a self-cleaning action, multiple seat design, and injection sealing for emergency conditions. The valves are available in ½-in. to 10-in. sizes with choice of standard flange connections.



Literature is available upon request to Seller Injector Corporation, 1617 Hamilton Street, Philadelphia 30, Pennsylvania.

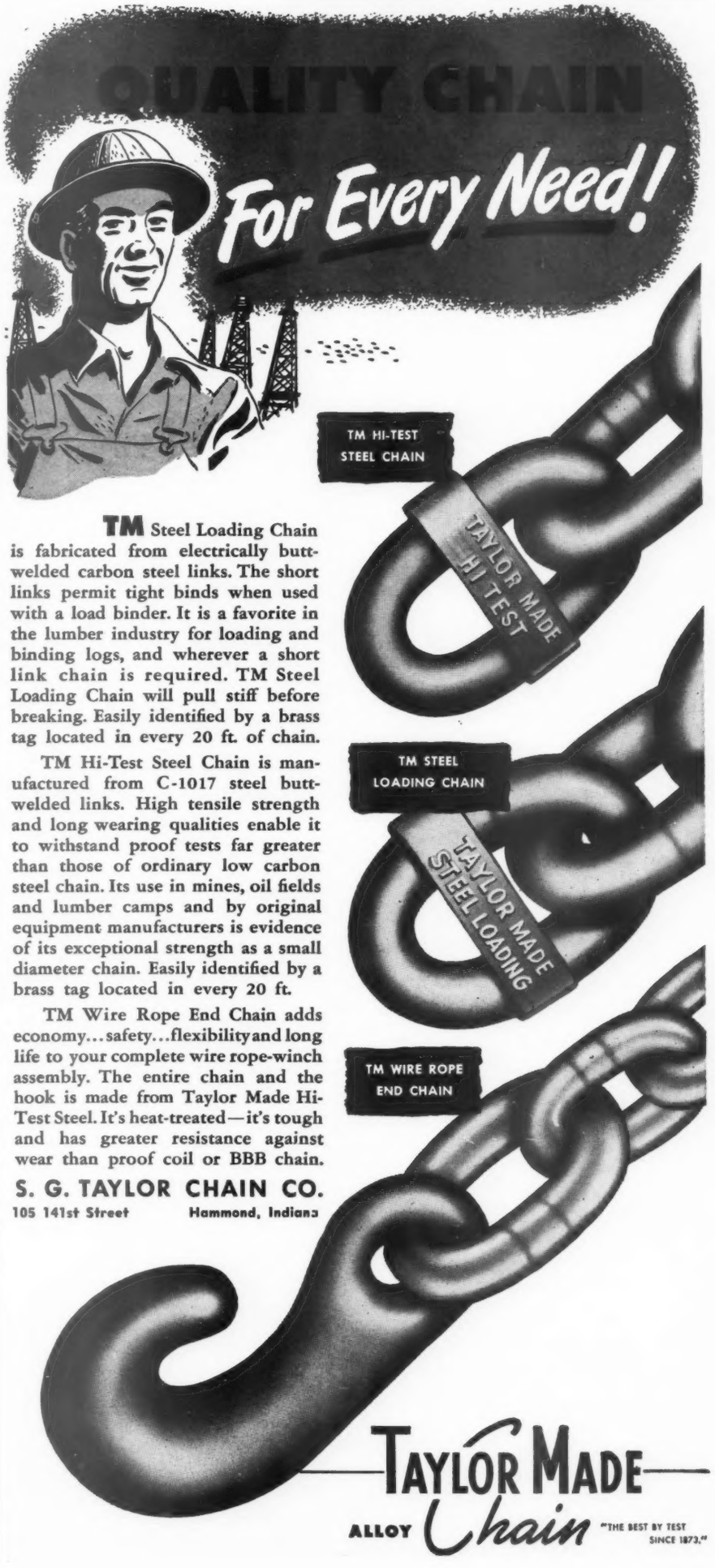
(17) Temperature Transmitter

A new force-balance type pneumatic temperature transmitter called the Taylor Transaire with Speed-Act has been announced by the Taylor Intrument Companies, Rochester, New York.

This new instrument is designed particularly for those applications where it is desirable to have the indication, record, or control remotely located from the point of measurement and where it is necessary to have accuracy, high speed of response, small thermal elements, and short range spans within the limits of minus 375 F and plus 1000 F.

The Taylor Transaire transmitter is a compact instrument fully encased to give adequate protection from dust and moisture. Convenient mounting brackets are also provided for pipe or wall mounting, or an adjustable bracket is supplied when the instrument is used with a separable bushing.

For further details write for Bulletin 98140, Taylor Instrument Companies, Rochester 1, New York.


QUALITY CHAIN
For Every Need!
TM HI-TEST STEEL CHAIN
TAYLOR MADE HI TEST
TM STEEL LOADING CHAIN
TAYLOR MADE STEEL LOADING
TM WIRE ROPE END CHAIN
TM Steel Loading Chain is fabricated from electrically butt-welded carbon steel links. The short links permit tight binds when used with a load binder. It is a favorite in the lumber industry for loading and binding logs, and wherever a short link chain is required. TM Steel Loading Chain will pull stiff before breaking. Easily identified by a brass tag located in every 20 ft. of chain.
TM Hi-Test Steel Chain is manufactured from C-1017 steel butt-welded links. High tensile strength and long wearing qualities enable it to withstand proof tests far greater than those of ordinary low carbon steel chain. Its use in mines, oil fields and lumber camps and by original equipment manufacturers is evidence of its exceptional strength as a small diameter chain. Easily identified by a brass tag located in every 20 ft.
TM Wire Rope End Chain adds economy... safety... flexibility and long life to your complete wire rope-winch assembly. The entire chain and the hook is made from Taylor Made Hi-Test Steel. It's heat-treated—it's tough and has greater resistance against wear than proof coil or BBB chain.
S. G. TAYLOR CHAIN CO.
105 141st Street Hammond, Indiana
TAYLOR MADE ALLOY Chain
"THE BEST BY TEST SINCE 1873."

(18) Felseal

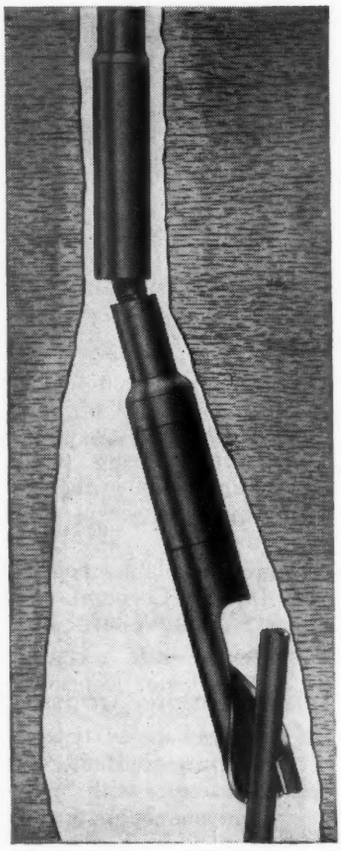
Felseal, a product development of Felt Products Manufacturing Company, Chicago, Illinois, is the answer to the increasing demands for lower cost and increased efficiency in gaskets and other types of seals, according to the company engineers. Use of higher temperatures, pressures, and generally stepped-up power ratios has led to the need for sealing materials with high resistance to pressures, chemical action, and heat, the manufacturer states.

Felseal is the answer, according to its makers, because it not only meets the severest service conditions but, in addition, reduces seal costs. It permits the use of inexpensive base materials, even for severe oil, fuel, and solvent applications. Furthermore, the high plastic flow of Felseal under moderate flange pressures saves costly machining. Castings and machined parts are sealed efficiently without using a finishing cut or surface grinding. Test samples of the Felseal coating are available without charge to interested industrial executives and product development engineers from Felt Products Manufacturing Company, 1508 Carroll Avenue, Chicago 7, Illinois.

(19) Knuckle Joint

The new LeBus FO-47 knuckle joint is unique in many respects. It has a full opening bore permitting use of inside cutters and logging instruments while in the hole. The ball and socket construction with trunnion pin permits the severest jarring, pulling and rotating. The knuckling action permits "reaching out." This is especially valuable should the lost string of pipe be located in a bad wash-out.

Knuckling action is obtained by dropping a restriction plug which seats itself in the control piston near



the top of the knuckle joint. The direct application of mud pressure through the fishing string by the regular mud pumps causes the knuckling action. Should inside cutters or other tools be required the restriction plug can be fished out with a small overshot.

The complete operation of the LeBus knuckle joint overshot fishing system is described in a free booklet available by writing to the LeBus Rotary Tool Works, Inc., P. O. Box 2352, Longview, Texas.

Editor's Note: In our April issue, item No. 9 about the new wellchecker produced by Rollo Manufacturing Company, we stated that this unit will handle 1000 bbl of fluid and 300 MCF of gas per day. That should read: "This unit will handle 1000 bbl of fluid and 3000 MCF of gas per day."

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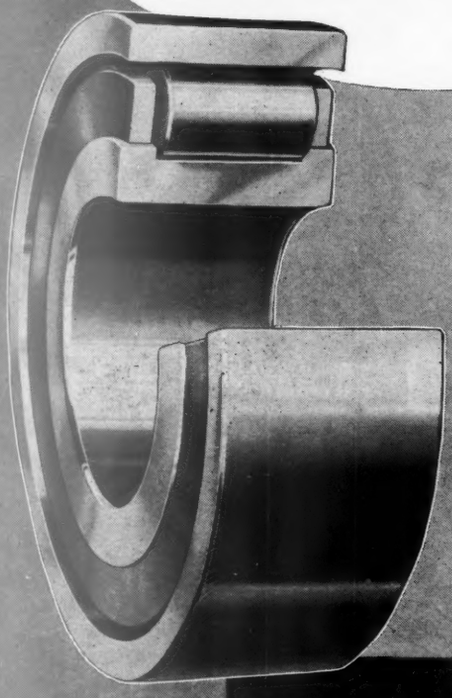

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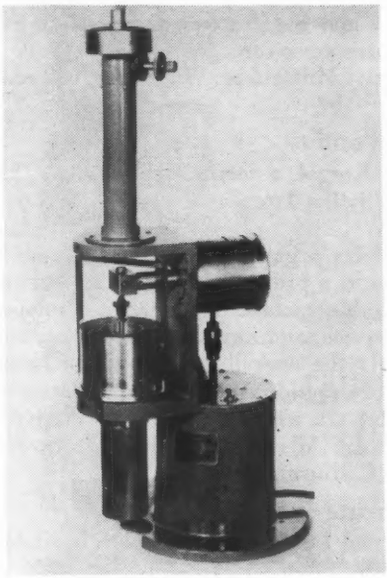
1718 S. Flower St., Los Angeles, Calif.

(20) Viscosimeter

Developed for The Texas Company by Dr. Allan D. Garrison, of Rice Institute, Houston, Texas, the Texaco viscosimeter was designed specifically for the measurement of viscosity in plastic fluids and thixatropic suspensions, or any other non-Neutonian fluid, in which viscosity varies both with rate of shear and with time, as in drilling muds and cements. It has been redesigned and improved over a period of more than three years' service in The Texas Company Producing Department Research Laboratories. Under agreement the viscosimeter is manufactured and distributed by Southwestern Industrial Electronic Company, 2831 Post Oak Road, Houston, Texas.



The instrument features: (1) a wide range of positive, fixed speeds; (2) stroboscopic arrangement for checking rotor speeds; (3) high velocities, to allow fluids to reach equilibrium viscosity; (4) continuous recording for any length of time; (5) completely friction-free torque measurement, due to torsion wire suspension; (6) oil damping, which insures steady readings on heavy fluids; (7) ample power to break jells, making accurate determination of jell strength possible; (8) agitation of entire sample; (9) special rotor and cup for laminar flow studies; (10) elimination of channeling; (11) use with various cups and rotors.

(21) Ratchet Adapter

Due to the compact design of Williams new patented ratchet adapter, ratchet action is possible in extremely limited quarters. Its use with any of the ½-in. square drive handles or attachments such as speeders, T handles, flex handles, etc., increases the versatility of the driver selected by converting it to a ratchet tool.

Williams ratchet adapter is made from selected alloy steel and is fully finished in bright chrome-plate. Length is 2-9/16 in., diameter 1¼ in. Ratchet-gear has 30 teeth and shift lever reverses action instantly.

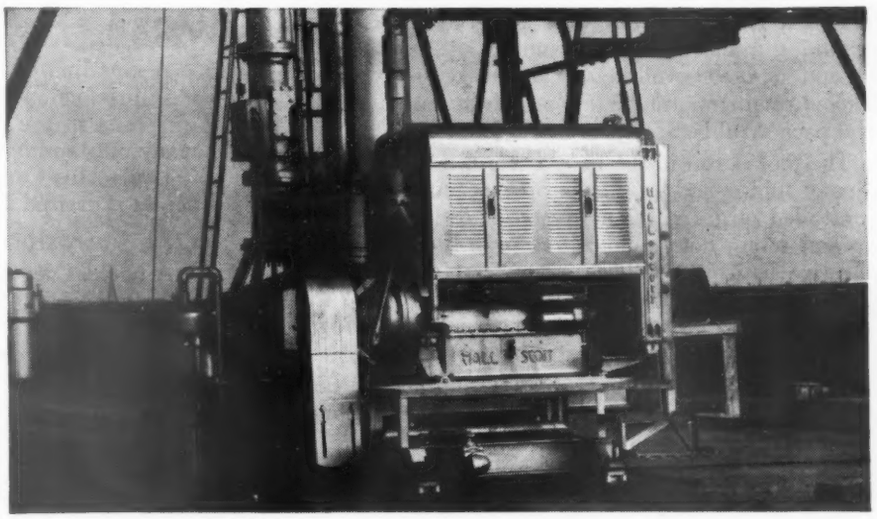
This ratchet adapter appears in Williams' A-50 booklet with a complete line of "Supersockets" and "Superrenches." Ask your dealer for a copy or write J. H. Williams and Company, 400 Vulcan Street, Buffalo 7, New York.

(22) Pipe-Stripping Buckets

Patented stripping buckets for stripping pipe for take-up and repair are now available at The Cleveland Trencher Company. The special buckets are designed for installation on the digging wheel of Cleveland's trenching machines.

The buckets are offered in two sizes, 16 in. and 22 in., stripping pipe from 4 to 16 in. in diam.

Details and literature are available by writing The Cleveland Trencher Company, 20100 St. Clair Avenue, Cleveland 15, Ohio.



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In pipeline, refinery, and field . . . Hall-Scott Engines deliver the extra power needed and require only routine maintenance. They burn natural gas, butane, or gasoline. Complete data on request.

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trade literature

PUBLICATIONS LISTED ARE SENT FREE UPON REQUEST

(23) Junk Snatcher

To meet today's demand for a hole free of junk in drilling and producing wells, The Cavins Company engineers designed and developed the Cavins "Multi-Surge" junk snatcher. This hydrostatic-action tool is run with drill pipe or tubing to clean out holes junked with small junk—rock bit cutters, blades, millings, scale, broken slips, dies, broken cement retainers, nipples, collars, short length of pipe, swab and packer rubbers, etc.

The tool is run in the hole assembled in a string of drill pipe or tubing and by simple top-hole manipulation, utilizes controlled surges of the hydrostatic head in the well to pick up and retain bottom-hole junk or fish. In addition to the effective hydrostatic surge action employed to wash junk into the tool, the snatcher can be rotated and used with milling shoes, and other attachments to remove bridges or to break, shape or center junk prior to each surge.

For further information a bulletin on this can be had by writing to The Cavins Company, 2853 Cherry Avenue, Long Beach, California.

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They're drop forged of mild steel, easily machined or welded. Meet ASA requirements and ASME and ASTM specifications. The Phoenix line is complete . . . that means dependable flanges for every job. Write for the Phoenix catalog today!
Flange & Hook Division
PHOENIX MANUFACTURING COMPANY
Catasauqua, Pa.
Joliet, Illinois

(24) Forged Steel Strainers

A new Edward bulletin providing information on forged steel strainers has been issued by Edward Valves, Inc. Edward strainers have an ASA rating of 600 lb at 850 F for steam, oil, or vapor, and a hydraulic rating of 1440 lb at 100 F. Bulletin 712 contains complete information on dimensions and weights, correct installation, maintenance, and cleaning. Edward Valves, Inc., East Chicago, Indiana, will supply copies of this bulletin upon request.

(25) Croloy Steels

The Babcock and Wilcox Tube Company now has available a convenient reference card on stainless Croloy steels for tubing, giving standard type numbers by which grades are identified, and chemical composition limits and ranges, based on ladle analyses.

The card, TDC-122, is available upon request to the company at Beaver Falls, Pennsylvania.

(26) Single Phase Motors

A new line of integral horsepower, single phase motors is in production by Louis Allis Company. A new approach was used in the design and construction of this line and many outstanding features are offered.

Louis Allis Company of Milwaukee, Wisconsin, will send copies if desired.

(27) Corrosion Preventive

A booklet describing Kontol, a corrosion preventive, has recently been published by the Tretolite Company, St. Louis 19, Missouri.

The Kontols are complex organic semi-polar compounds that firmly adsorb to form a protective film on the surface of the corrosion-vulnerable metals. They were developed specially for oil field service, and have proved, in use, that they reduce substantially the overall corrosion and lessen the tendency toward pit formation, states the manufacturer.

Copies of this booklet are available from the Tretolite Company at St. Louis 19, Missouri, or 5515 Telegraph Road, Los Angeles 22, California.

(28) Locomotive Crane

The American Hoist and Derrick Company has available a new catalog covering its 30-ton diesel locomotive crane.

The 20-page catalog contains illustrations of the crane in different types of work. Many mechanical illustrations are also included.

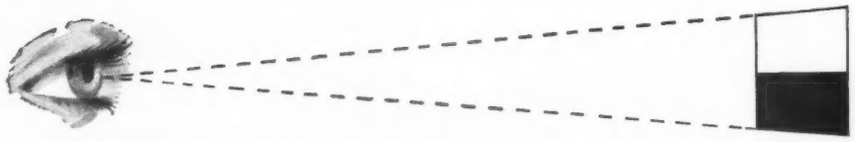
The catalog may be obtained by writing the Advertising Department, American Hoist and Derrick Company, St. Paul 1, Minnesota, asking for Catalog No. 600-L-6.

(29) Tool Joint Troubles

Soon to be released by the Hughes Tool Company is a new technical manual titled "Care and Operation of Tool Joints and Drill Collars." "The purpose of this booklet," as explained by M. E. Montrose, Hughes vice president in charge of sales, "is to provide the industry with a practical handbook which we hope will prove of assistance in eliminating unnecessary tool joint troubles." The brochure is not of an advertising nature, but rather a factual presentation of the tool joint and drill collar failures most likely to worry the present-day operator.

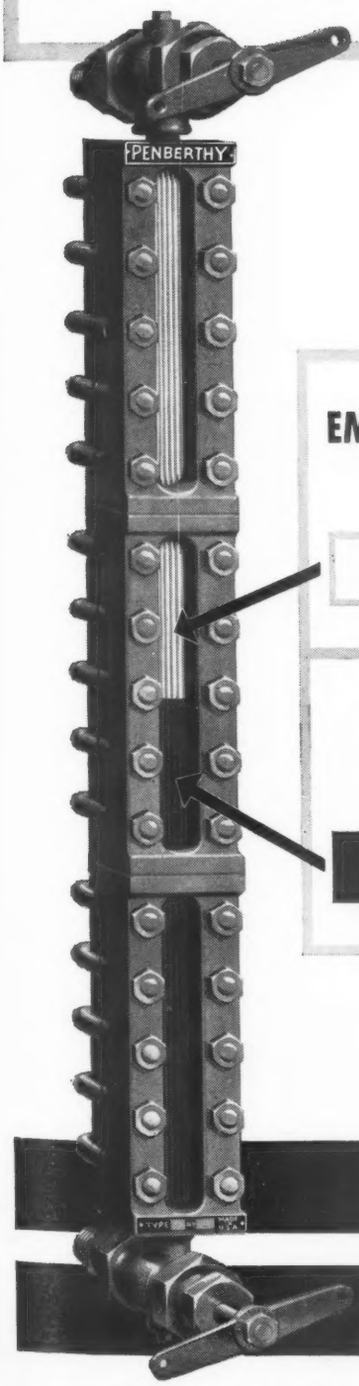
The foreword of the manual points out that since modern advances in tool joint design and construction have in such large measure eliminated the former failures of tool joint to drill pipe connection, the text of the book deals fully with tool joint troubles in pin and box connection. The operational practice that will eliminate the common causes of pin and box failure are discussed at length.

If you would like a copy of "Care and Operation of Tool Joints and Drill Collars," send a card or letter to the Hughes Tool Company, Post Office Box 2539, Houston 1, Texas.



YOU CAN READ

the PENBERTHY Reflex GAGE as far as you can distinguish between BLACK and WHITE



There can be no mistake in reading the Penberthy Reflex Gage. Due to the optical effect of the prismatically grooved glass, the liquid always shows black, and the empty space white. This optical effect is unvarying and absolutely sure. As a result, you can read the gage correctly as far as you can distinguish black and white . . . read it at a glance. There is no squinting to see the meniscus . . . the dividing line between liquid and empty space is always sharp and unmistakable.

In addition to standard units, Penberthy Reflex Gages are also fabricated to customer's specifications from special alloys to meet unusual corrosive and temperature conditions. They conform with API-ASME requirements.

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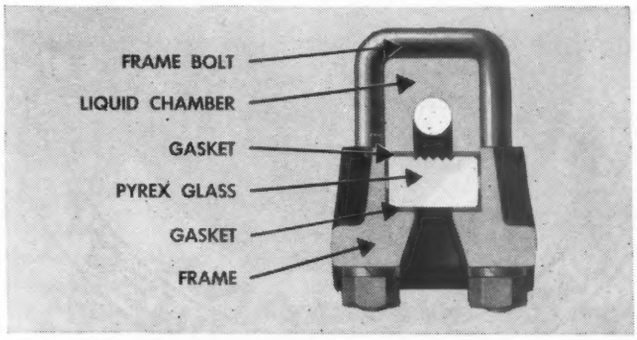

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PENBERTHY Reflex

DROP FORGED STEEL • LIQUID LEVEL GAGES

(30) Magnesium Anodes

Dowell Incorporated, Kennedy Building, Tulsa, Oklahoma, has issued a pamphlet that gives general information on magnesium anodes for cathodic protection. The various types and forms of magnesium anodes available are shown in drawings and described. It is pointed out that the type of anode chosen depends upon the application involved and the soil or water conditions encountered.

(31) A-C Generators

A new 16 page publication E-M Synchronizer No. 27 contains valuable information on how to select a-c generators, paralleling a-c generators, boosting capacity to meet electric power demand, and applying "packaged" generators in industry.

Published by Electric Machinery Manufacturing Company, Minneapolis 13, Minnesota.

(32) Oil Burners

Black, Sivalls & Bryson, Inc., Catalog 54, part 6, section 3, covers oil burners for BS&B internal fireboxes. The fully automatic burner can be used on BS&B internal fireboxes which are installed in emulsion treaters, volume type treaters, or internal firebox heaters. Power, installation and specifications are given.

(33) Corrosion Control

A new 28-page manual describing methods employed to protect underground pipe lines from corrosion and the role of Fiberglas pipe wrap in corrosion control may be obtained from Owens-Corning Fiberglas Corporation, Toledo 1, Ohio. Test data on the properties and performance of Fiberglas pipe wrap are included. The manual is illustrated with charts and photographs.

(34) Preformed Wire Rope

A new folder has just been released by Macwhyte Company giving questions and answers on Preformed wire rope, stating questions normally asked about this product and giving the answers.

Copies are available by writing to Macwhyte Company, Kenosha, Wisconsin, or any of its distributors.

(35) Turbine Pump

A Johnston turbine pump for every water transfer job in the wide ramification of oil operations, from drilling to refining, is the theme of an interesting and well illustrated brochure recently released by Johnston Pump Company, Los Angeles, California. The text deals with the many applications for which the Johnston turbine pumps are designed; explains how interchangeability of parts still further extends their utility and economy; and by means of a sectional drawing shows all the component parts of the pump, their relation to each other, and the *modus operandi* of the complete mechanism. Part of the Johnston strategy, developed through some 40 years of experience, involves the employment of a special impeller for each specific pumping purpose.

(36) Bouncing Pipes

The Burgess-Manning Company announces that it has available for free distribution a 15-page booklet entitled "Bouncing Pipes" by R. L. Leadbetter, research director. "Bouncing Pipes" tells the story of oscillating molecules that impede the smooth flow of gas and air through pipe lines, and offers a solution of this expensive, time consuming and hazardous problem through the use of "Snubbers."

The booklet may be had upon request by writing the Burgess-Manning Company, Libertyville, Illinois.

DEAN BROTHERS PUMPS INC. INDEANAPOLIS, INDEANA. PUMPING MACHINERY

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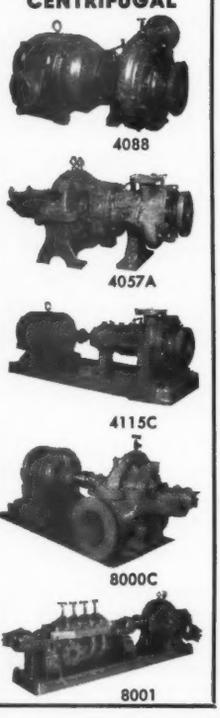
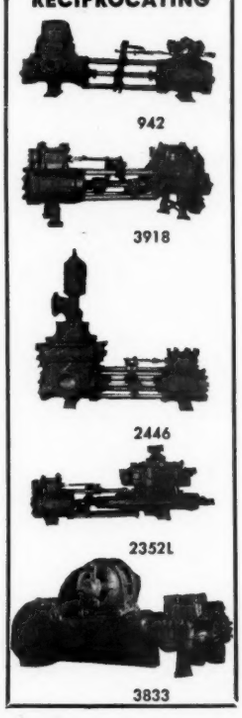


RECIPROCATING



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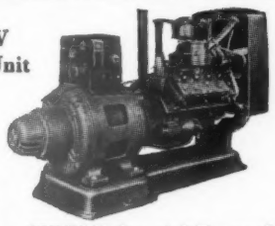
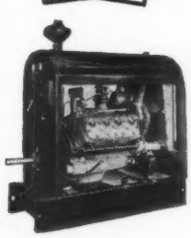
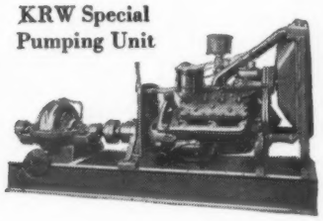
THE 100-H.P. FORD V-8

KRW 20KV Generating Unit





KRW Special Pumping Unit



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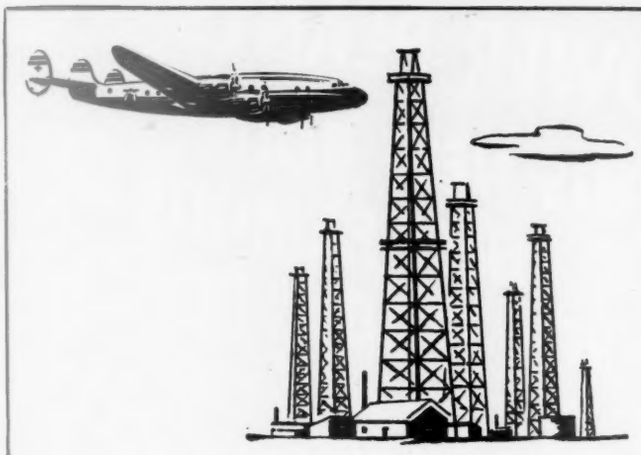

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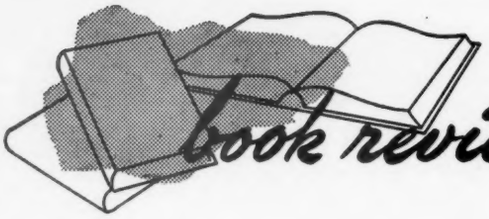

Proceedings of the National Conference on Industrial Hydraulics, Vol. II. *Armour Research Foundation of Illinois Institute of Technology, Technology Center, Chicago 16, Illinois. Pages, 154. Price, $3.*

This volume contains the complete text of the 13 papers presented to the fourth meeting of the National Conference on Industrial Hydraulics, October, 1948. As an example of subjects discussed and of particular interest to technically-minded car owners was a description of Buick's Dynaflow, under the paper title of "The Poly-Phase Torque Converter."

Arabian Oil, *by Raymond F. Mikesell and Hollis B. Chenery. University of North Carolina Press, Chapel Hill, North Carolina. Pages, 201. Price, $3.50.*

The authors have provided a concise account of the United States' petroleum position in the Middle East from 1930 to summer's-end 1948. They present the development of Arabian oil resources by U.S. firms as a case study in foreign policy with respect to a strategic material. In their conclusions relative to general policy, they favor international agreements for carrying out recommendations on a voluntary basis rather than the establishment of a world petroleum authority.

Isotopes and Their Application in the Field of Industrial Materials, *by Paul C. Aebersold. American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pennsylvania. Pages, 28. Price, $1.*

This paper by the Chief of the Isotopes Division, Atomic Energy Commission, was the 1948 Edgar Marburg Lecture. These annual lectures, honoring the memory of ASTM's first secretary, are presented by leaders in their respective fields on outstanding developments in the promotion of knowledge of engineering materials.

The Behavior of Rocks and Rock Masses in Relation to Military Geology, *by Lieut. Col. Wilmot R. McCutchen. Quarterly of the Colorado School of Mines, Vol. 44, No. 1, Golden, Colorado. Pages, 76. Price, $1.*

Properties in rocks, such as elasticity and plasticity, are treated, and the failure of rocks under stress is discussed. Several examples of loading on rock masses, including stress distribution around a tunnel opening, propagation of elastic strain, and crater blasting, and the principles of similitude as they may be used in military geology are treated, with an example presented that involves the detonation of an atomic bomb above an underground tunnel.

Examination and Valuation of Mineral Property, *edited by Roland D. Parks. Addison-Wesley Press, Inc., Cambridge 42, Massachusetts. Pages, 504. Price, $5.00.*

Included in this third edition of the original "Mine Examination and Valuation," by Baxter and Parks, is a 43-page section on Valuation of Oil Property by Walter L. Whitehead, associate professor of geology, Massachusetts Institute of Technology. This new section contains chapters on property rights, field examination and valuation factors, and an oil field valuation problem that is worked out in some detail to demonstrate the principles involved.

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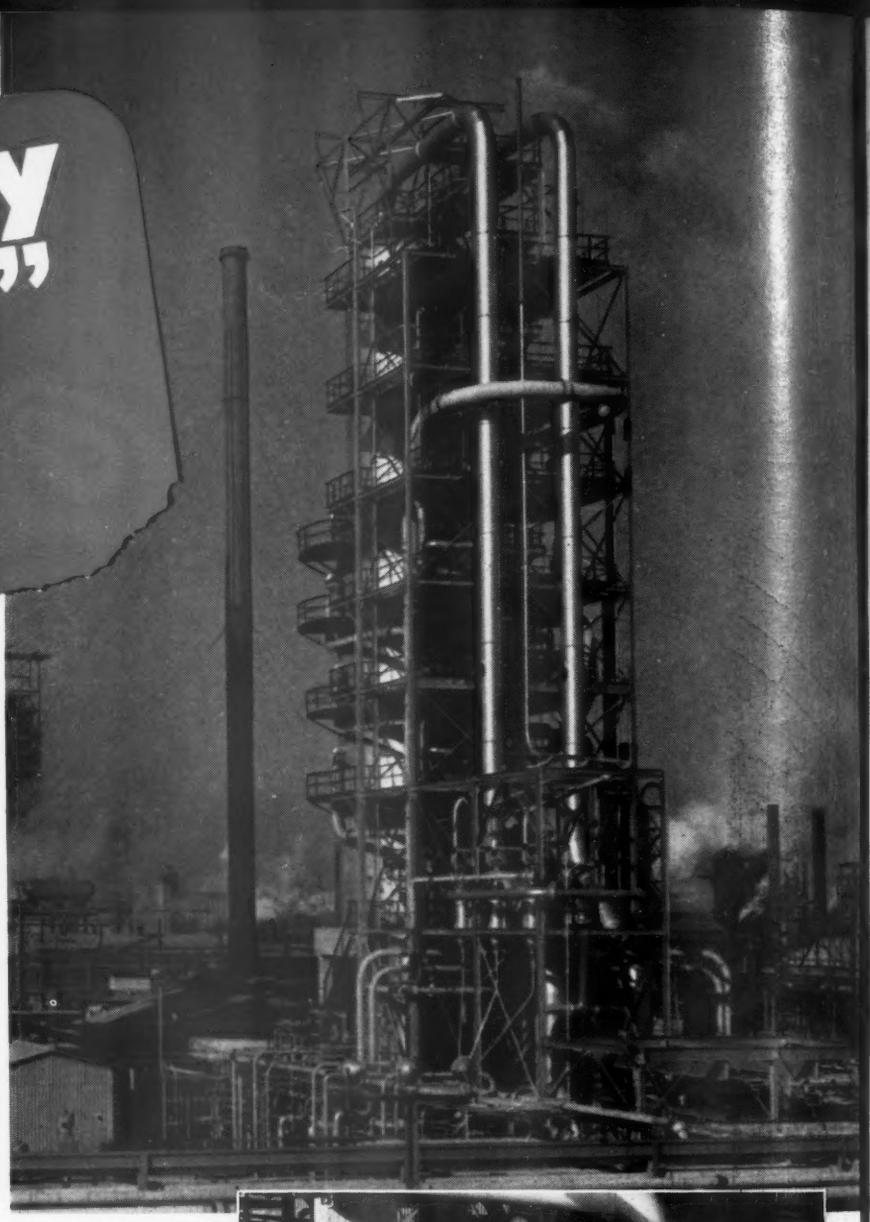
JUNE 1949

Refinery "finery" by CB&I



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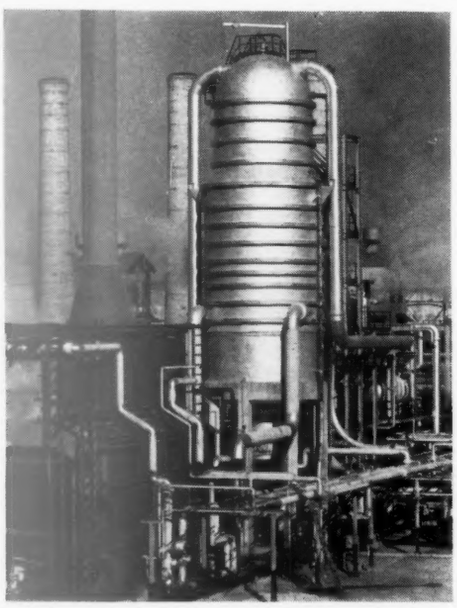
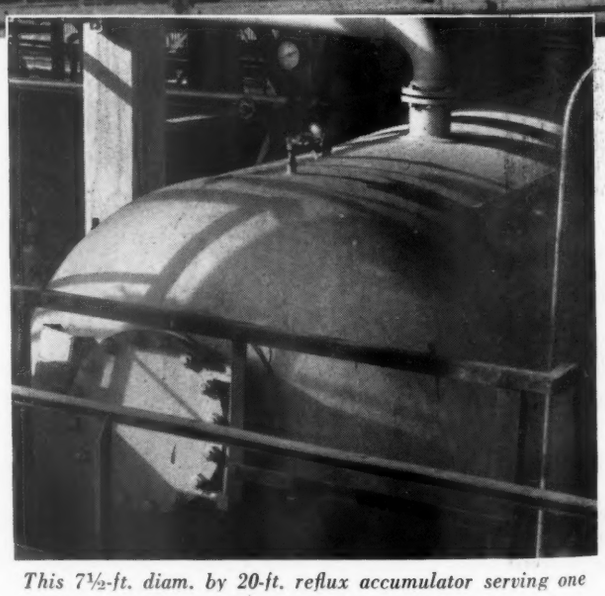


Above: CB&I field-erected vacuum tower serving a pipe still at the Esso Standard Oil Company refinery at Baton Rouge, La. This unit is 109 ft. high.

Left: A CB&I vacuum column serving another pipe still at the Baton Rouge refinery. This structure is 20 ft. in diam. by 64 ft. 6 in. high.



This 7½-ft. diam. by 20-ft. reflux accumulator serving one of the pipe stills at Baton Rouge is monel-clad for corrosion resistance. Design pressure is 50 lbs. per sq. in. at 650° F.

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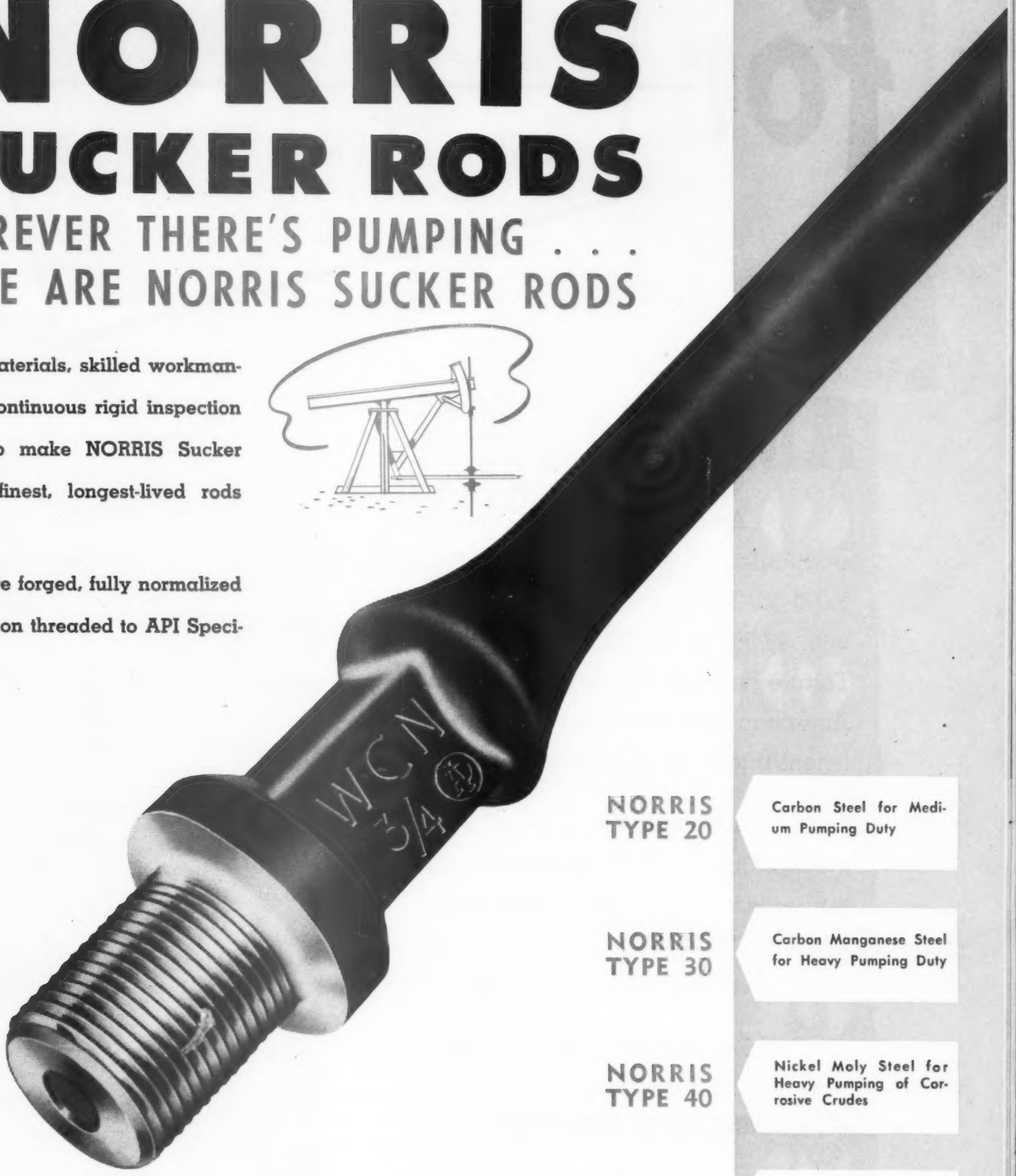

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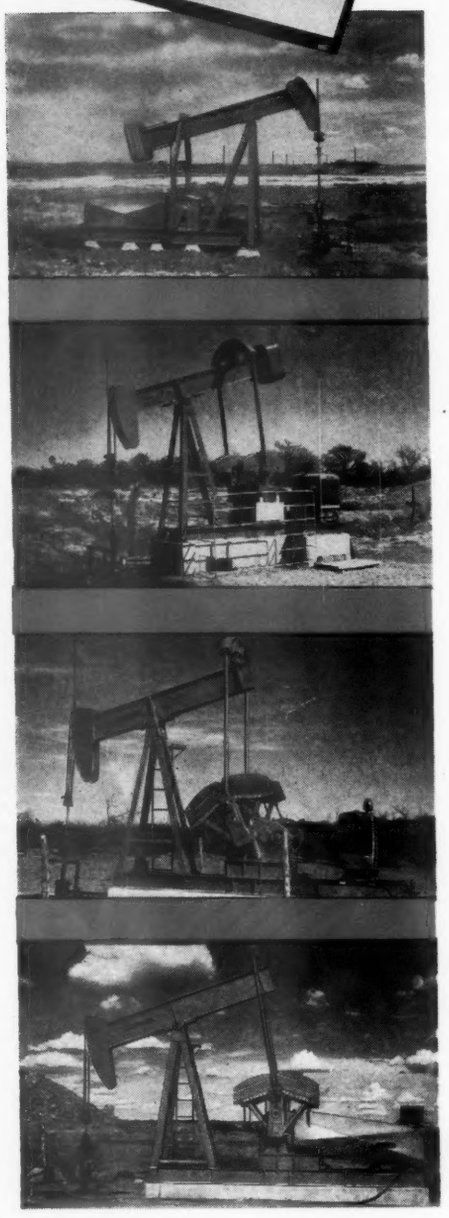

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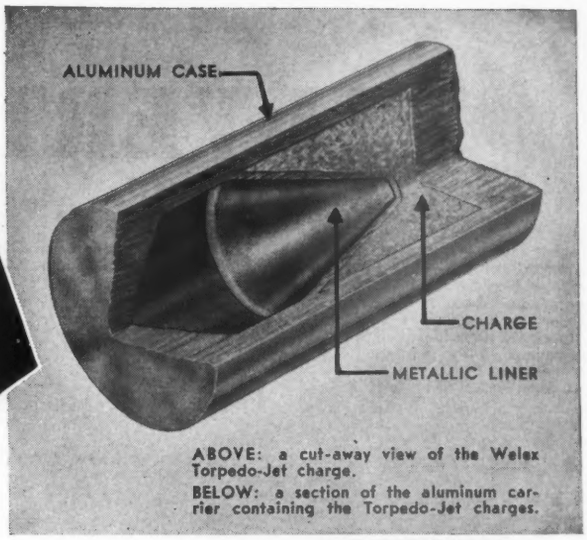
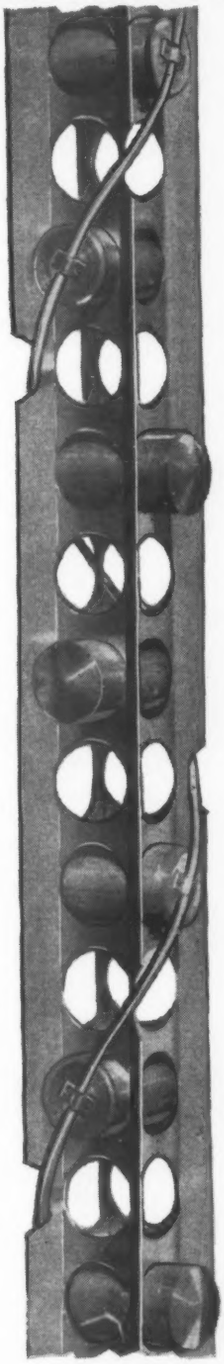


ABOVE: a cut-away view of the Welex Torpedo-Jet charge.
BELOW: a section of the aluminum carrier containing the Torpedo-Jet charges.



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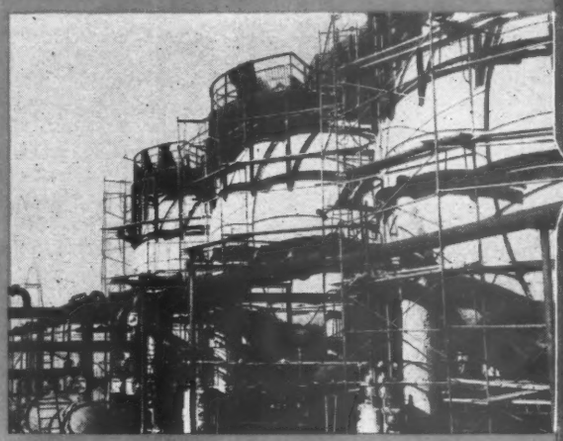

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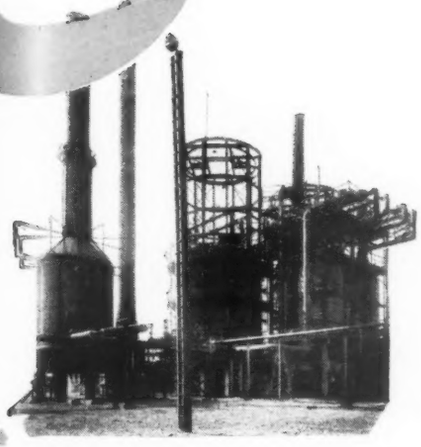

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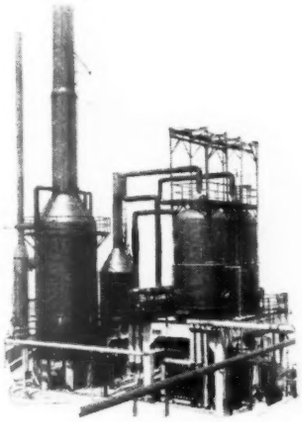

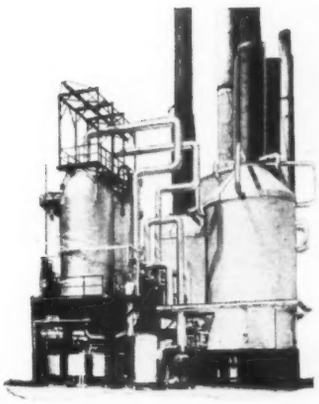

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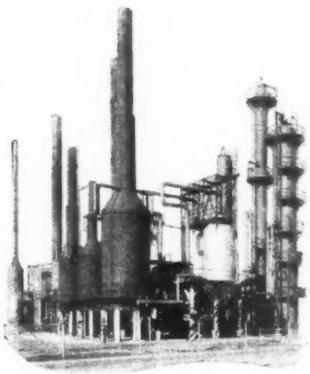

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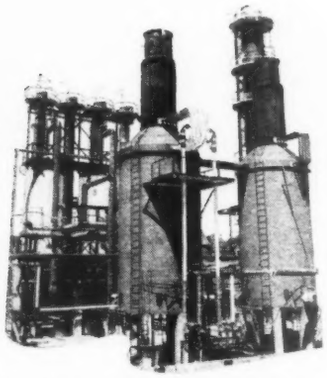

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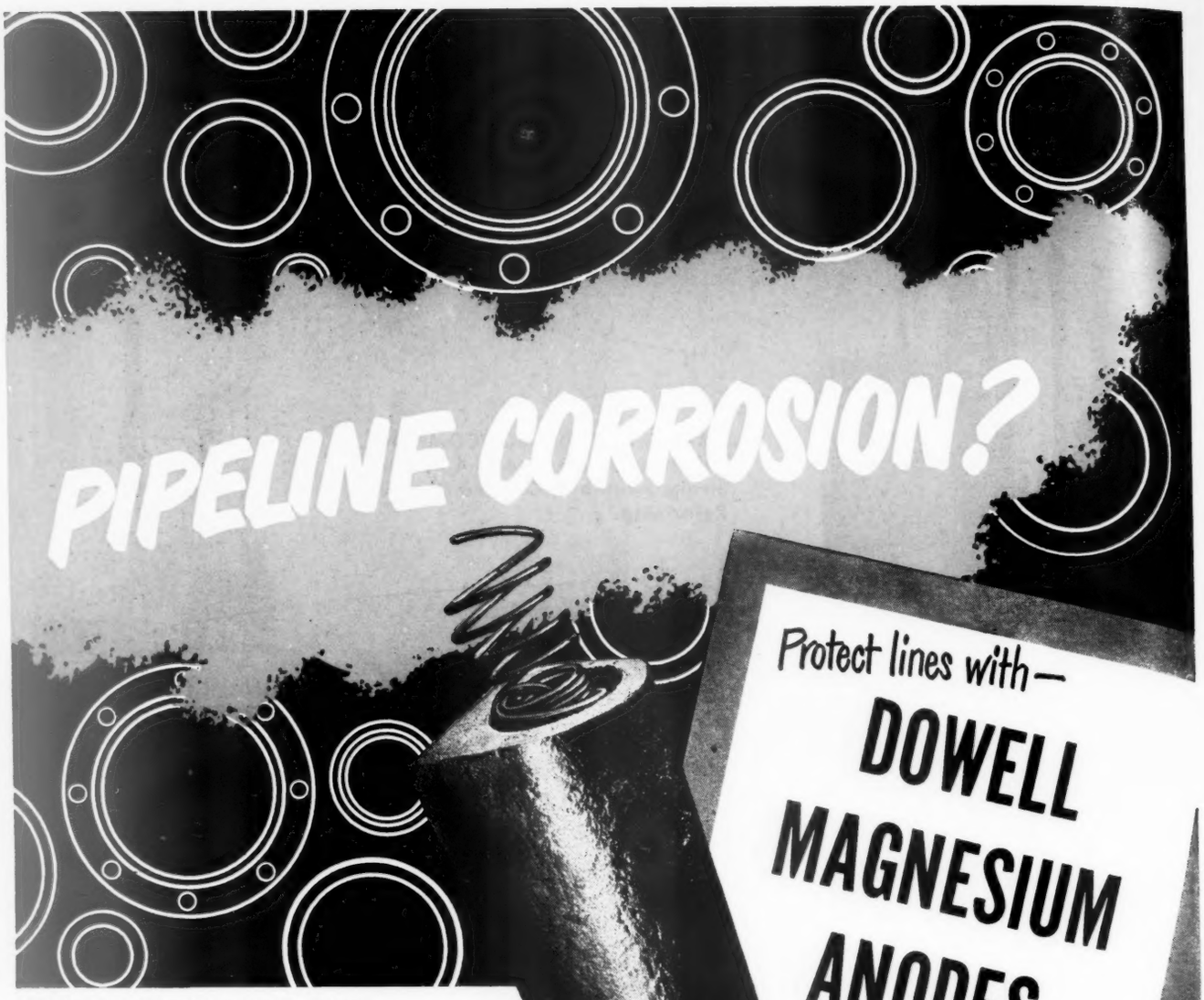

LINE LEAKS REDUCED 90%
BY INSTALLATION OF
DOWELL MAGNESIUM ANODES

Here is a maintenance-free method of corrosion control that requires no external source of power. Installed when the pipe is originally laid down—or placed at "hot spots" in existing installations, magnesium anodes are proving themselves to be an effective, low-cost form of cathodic protection for control of underground corrosion.

For example, leaks on an uncoated line running through a swamp averaged 500 per year. The installation of a Dowell magnesium anode protection system reduced the number of leaks by 90%, saving thousands of dollars in maintenance costs and damages. A similar application of Dowell anodes on a second line paid for itself in six months.

For magnesium anodes, look to Dowell, a subsidiary of The Dow Chemical Company which developed this effective form of cathodic protection. Dowell engineers can give you the full benefit of their long association with the petroleum industry—plus the joint research of both Dow and Dowell. For complete information, write to Tulsa.

DOWELL INCORPORATED
TULSA 3, OKLAHOMA
Subsidiary of The Dow Chemical Company

Look to
DOWELL
MAGNESIUM ANODES FOR
CORROSION CONTROL

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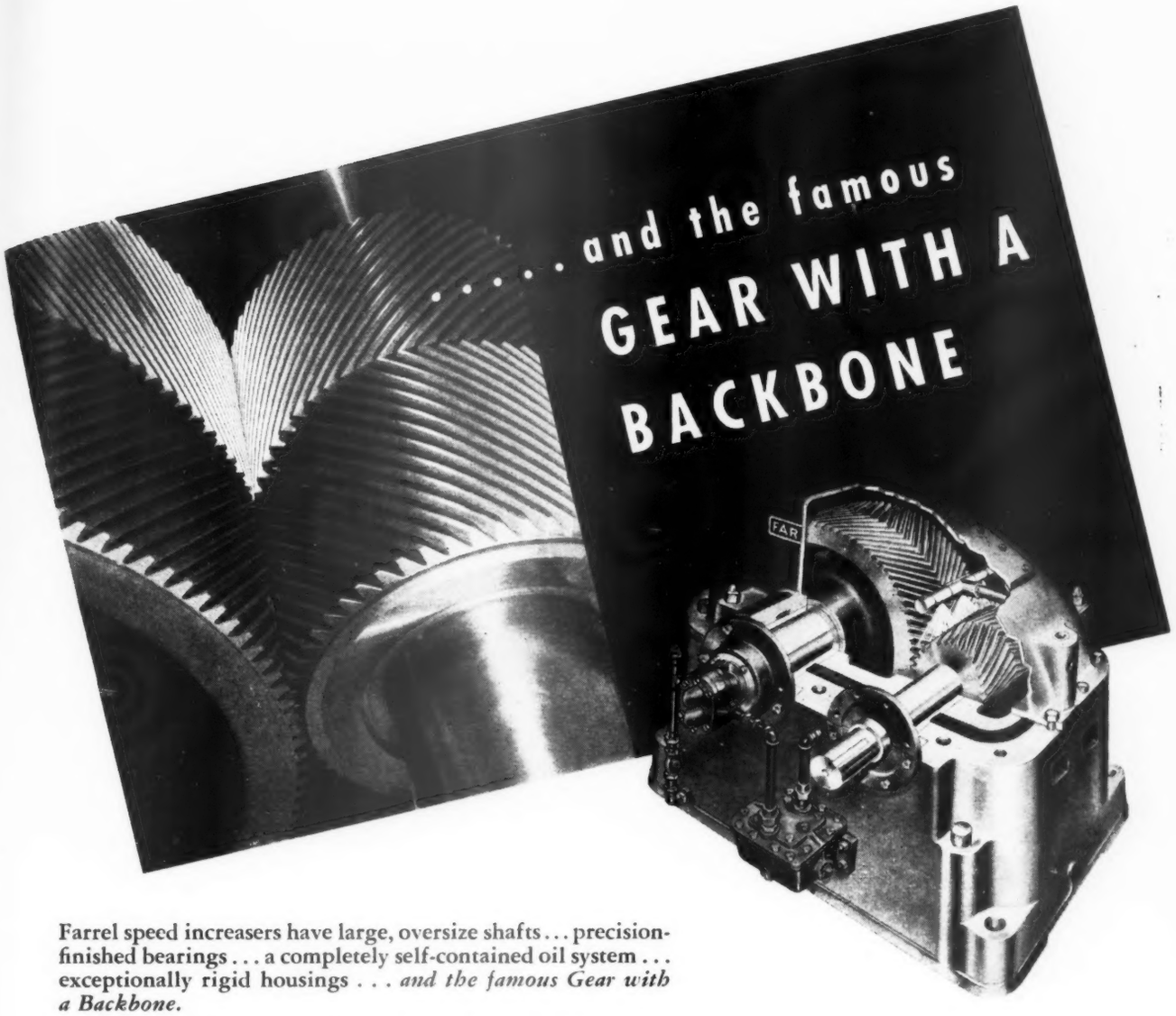
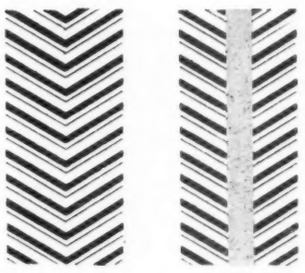


Farrel speed increasers have large, oversize shafts . . . precision-finished bearings . . . a completely self-contained oil system . . . exceptionally rigid housings . . . *and the famous Gear with a Backbone.*

These gears are the continuous tooth herringbone design, precision generated by the Farrel-Sykes process. Because there is no useless center groove separating the two helices, the entire face width of the gear is put to work, providing extra strength and higher load-carrying capacity in smaller space. This is a definite advantage where continuous, trouble-free service is a "must."

Farrel speed increasers are made in 49 standard sizes with speed ratios ranging from 1:1 to 12:1. For higher ratios, units using two sets of gears are supplied with ratio range from 12:1 to 40:1.

For full information about the speed increaser with the famous *Gear with a Backbone*, write for a FREE copy of Bulletin No. 448.



This comparison shows the greater tooth area of the *Gear with a Backbone* (left) which gives it increased load-carrying capacity over the conventional gear with center groove (right).

FARREL-BIRMINGHAM COMPANY, INC., 344 VULCAN ST., BUFFALO 7, N. Y.

Plants: Ansonia and Derby, Conn., Buffalo, N. Y. *Sales Offices:* Ansonia, Buffalo, New York, Boston, Pittsburgh, Akron, Cleveland, Detroit, Chicago, Los Angeles

OIL FIELD REPRESENTATIVES—Hercules-Lupfer Engine Sales Co., 124 N. Boston St., Tulsa 1, Okla.; V. W. Osborne, 822-A M & M Building, Houston 2, Texas

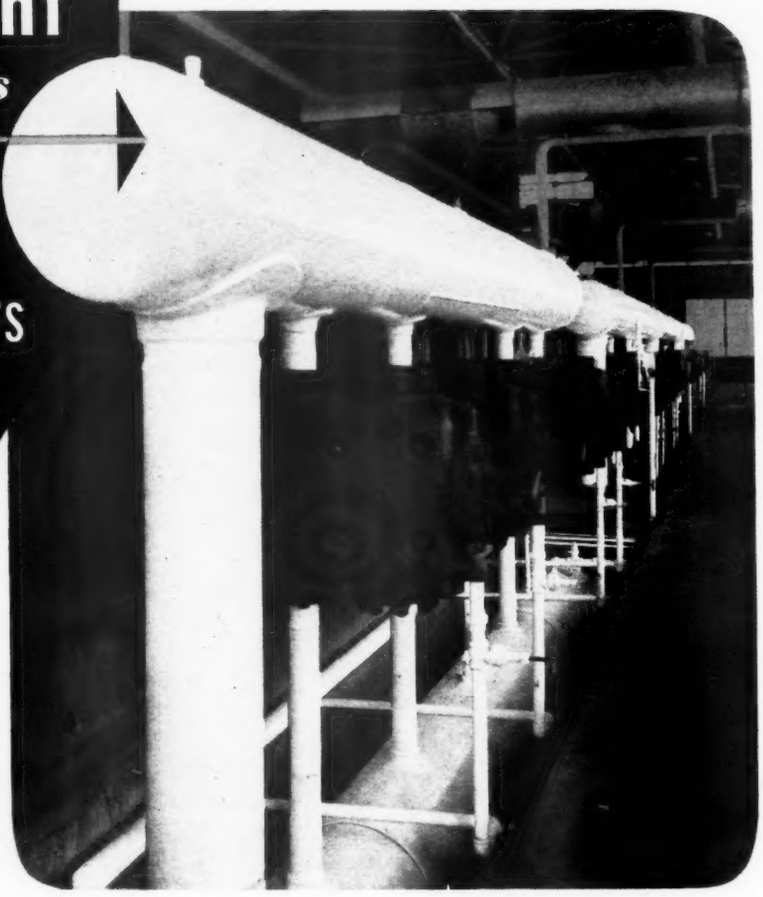
Farrel-Birmingham

FB-546

XUM

1 cure · 2 prevent *pipe-line quivers with* FLUOR Pulsation Dampeners

Pipe vibration from gas-compressor pulses costs money — in repairs, in power consumption, and in meter inaccuracy. It can also cost Human Life.



Fluor pulsation dampeners were installed as original equipment on the 1200-mile natural gas line from West Texas to Southern California. This view in a main line station at Tucson, Arizona shows Fluor pulsation dampeners on both the suction and discharge sides of the compressors. These dampeners are paying for themselves by permitting the required gas flow to be maintained with minimum horsepower.

1 cure

Where pulsative gas flow is already setting up destructive vibrations and instrument irregularities, Fluor pulsation dampeners can be installed as a complete remedy.

2 prevent

On new installations, wherever there is danger of pulsation, you can safeguard compressor efficiency, reduce operating costs, and avoid headaches in general with proper pulsation-dampening units. You **save** money by buying Fluor pulsation dampeners to ***remove*** pulses instead of buying oversize pipes with necessary anchorages to ***resist*** them.

BE SURE WITH FLUOR

FLUOR

THE FLUOR CORPORATION, LTD.

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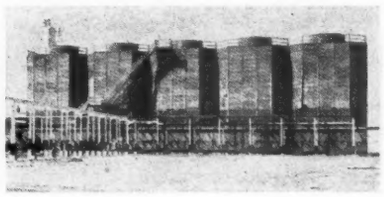
NEW YORK · PITTSBURGH

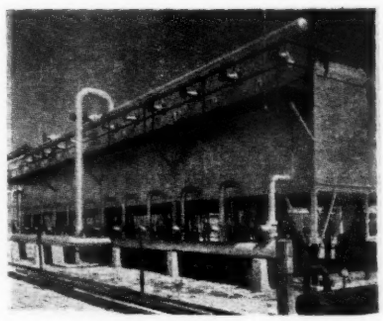
Aerator Towers

Fluor Aerator cooling towers have distinctive economy features and are most practical in certain cooling applications.



Counterflo Towers

Fluor Counterflo induced-draft cooling towers are a standard of industry for most water-cooling applications. They deliver "colder water cheaper."



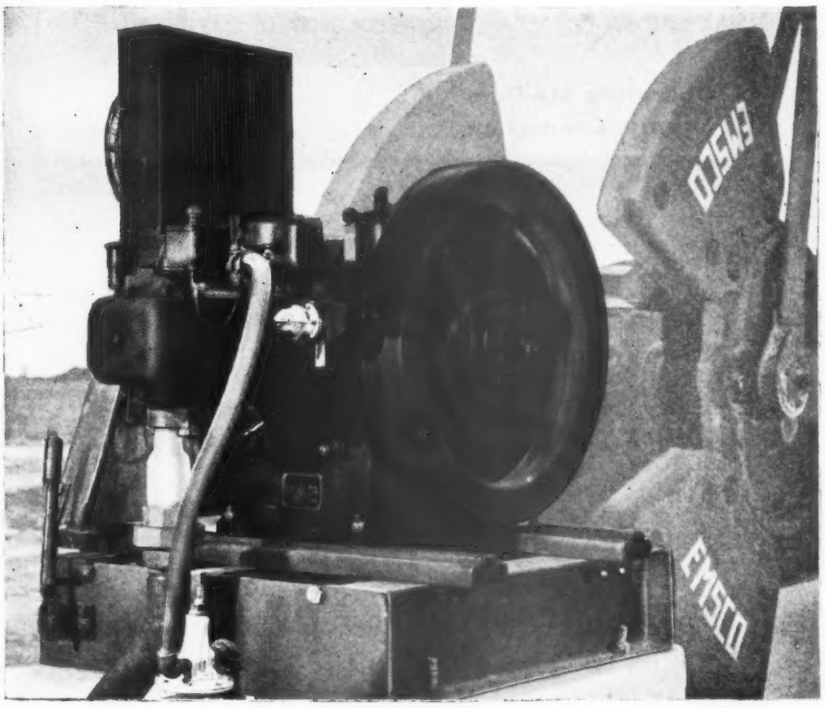
Fin · Fan Units

Fluor air-cooled heat exchangers are more economical where make-up water is expensive, where water has bad scaling characteristics, and where the temperature of liquid to be cooled is relatively high. (Manufactured and sold by Fluor and Griscom-Russell Co.)

THE BULLFROG HAS
POWERFUL HIND LEGS*
Why?
*Designed For a
Specific Purpose
Thanks to nature, the bullfrog's powerful hind legs serve him equally well on land and in the water. Either place, he can leap quickly on insects for food. When on the bank he can jump fast and far to the water, then swim swiftly for an unlimited time.

THE CSCO PUMPING ENGINE

. . . Designed For a Specific Purpose



TO PUMP OIL

The CSCO is not an adaptation of an engine originally created for another purpose. The CSCO line of Pumping Engines was designed without compromise to meet all pumping requirements . . . every element deliberately engineered by men long experienced in oil well pumping.

CSCO Pumping Engines have been operating for four years under every possible condition. Today's performance of those in service during that period justifies the judgment of designing a pumping engine for a *specific purpose.*

THE CSCO 96 - 66 - 46

Enclosed to conquer dirt . . . Pressure Lubricated to conquer wear . . . Steam Cooled to conquer heat and cold . . . Heavy Flywheel to conquer peak load.

Ask a Continental Man for complete details

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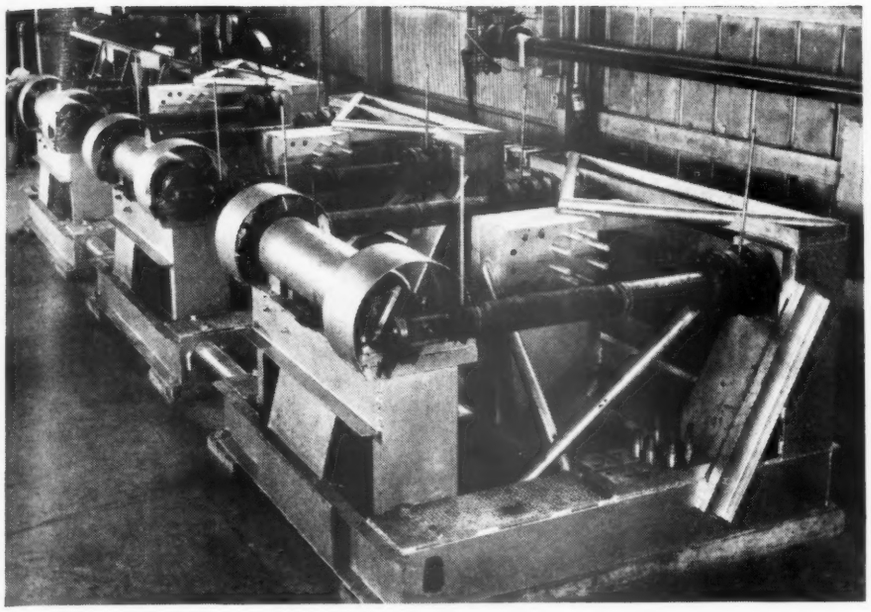
A
COMPLETE
Packaged
ASSEMBLY
ONLY 2 CONNECTIONS TO MAKE
Easy DOES IT
INTEGRALLY MOUNTED COMBINATION TYPE 67FR FILTER-REGULATOR NOW ELIMINATES USUAL PIPING DETAILS AND FITTINGS
Operating Medium Supply Connection
Instrument Air Connection
FISHER
DIAPHRAGM
MOTOR VALVE
It's "factory piped". Filter is bolted to yoke with two cap screw bolts.
Fisher Diaphragm Motor Valve Top Works are now regularly equipped with mounting pads for auxiliary units such as filter and positioner.
FISHER GOVERNOR COMPANY
MARSHALLTOWN, IOWA



Strength through Design in Tube-Turn welding flanges

Taking the measure of piping fatigue

PIPE lines are *live, dynamic* members of a piping system. They *breathe* with changes in temperature and pressure. And the danger of fatigue failure from pressure shock, thermal shock, and cyclic conditions is ever-present.

More precise information was needed on this subject. So, Tube Turns research engineers set out to get the answers. For the purpose, they designed and built a unique cyclic testing machine to handle full-size piping assemblies under a wide range of temperature, pressure, and corrosive conditions. And on this torture rack they subjected flanged assemblies to reverse bending tests carried on to ultimate failure. Information revealed forms the basis of new designs for greater strength in Tube-Turn welding flanges.

Other piping assemblies, too—welding elbows, mitre bends, manufactured and fabricated tees, pipe bends—have been subjected to punishment more severe than any they would probably face in normal service.

And this perpetual search for greater strength through better design has paid off in the form of realistic, non-theoretical facts providing a sound basis for Tube Turns' manufacturing policies—facts important to anyone interested in getting his money's worth in long life from piping installations.

Tube Turns' research and development organization, finest in the welding fittings industry, is constantly striving for the improvement of present products, the development of new ones. Notable among their recent achievements have been the design of a new type welding tee and the development of aluminum welding flanges.

Ask to be put on the mailing list for Tube Turns' technical periodical, *Piping Engineering*. Paper 6.01, for instance, deals extensively with standard steel flanges. Others give you research findings and additional working information pertaining to piping not generally available in convenient form.

TUBE-TURN

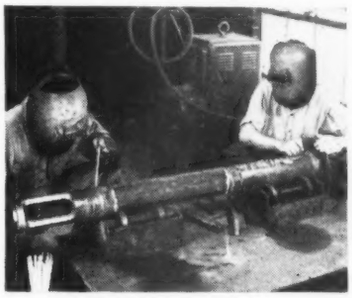
WELDING FITTINGS AND FLANGES

TUBE TURNS, INC.

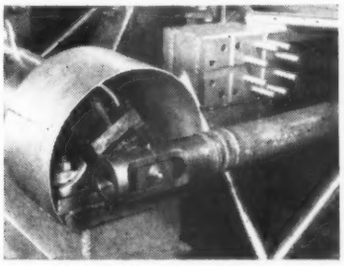
242 East Broadway, Dept. H, Louisville 1, Kentucky

District Offices at New York, Philadelphia, Pittsburgh, Chicago, Houston, Tulsa, San Francisco, Los Angeles

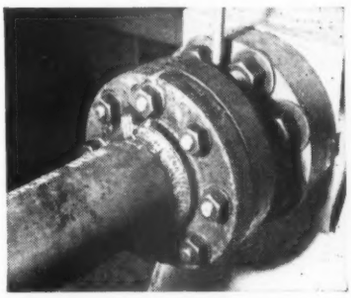
TYPICAL FLANGE ASSEMBLY TESTS



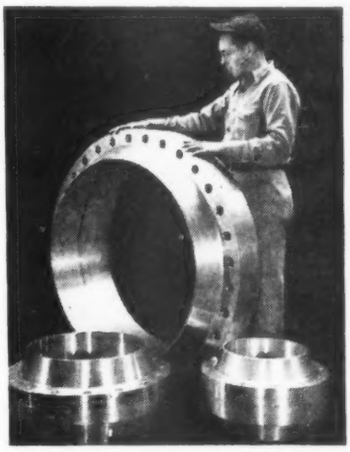
Assemblies were of 4-inch nominal size with 300 pound forged steel flanges and standard weight pipe.



Eccentric crank arm produces up-and-down movement which creates a cyclic bending moment on flange or fitting at opposite end of assembly.



Water spurts from crack in test specimen. Almost invariably, failure occurred in the pipe adjacent to the flange.



Aluminum welding flanges . . . another Tube Turns first! Available in a wide range of types and sizes.

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America Needs '49ers

JUST a hundred years ago, the Forty-niners stormed the gold fields of California. They faced staggering obstacles, sure hardship, uncertain reward. Thousands failed, thousands of others realized modest gain, a few made fortunes. None sought or received help or direction from a benevolent government.

Now a century later, America faces another age of golden opportunity--an era when science and industry reveal new treasure to be had for the making. Turning today's visions into reality calls for '49ers--men of purpose and resolution, courage and independent spirit. You as a leader in your community may find a personal challenge and an inspiration in the Old '49er. By example and precept, you can help America toward her greatest accomplishments--in prosperity and peace.

The Youngstown Sheet and Tube Company

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MANUFACTURERS OF CARBON, ALLOY AND YOLOY STEELS

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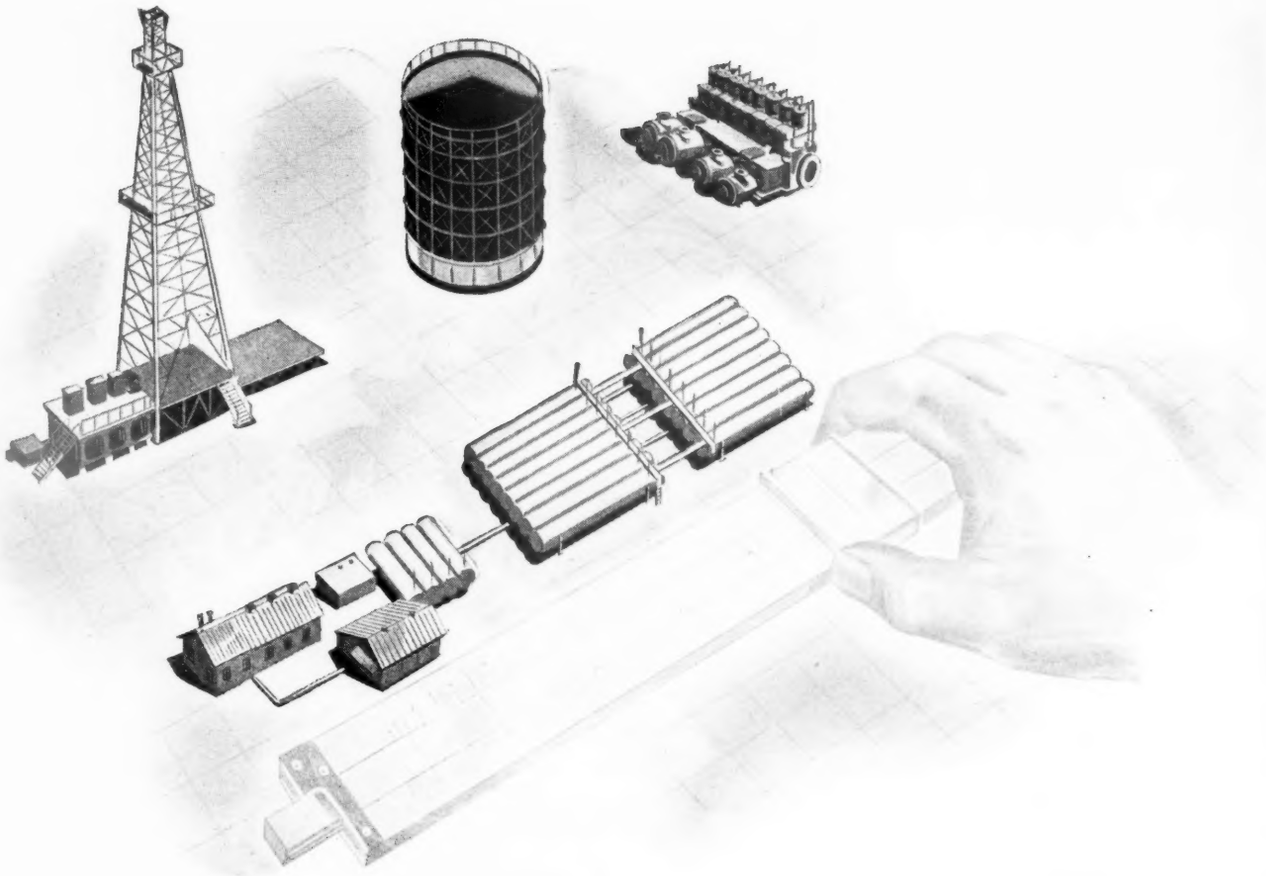

How would you measure an unborn giant?

Suppose you had a tract of rich, virgin oil land. Even to estimate your needs for full development would be a giant job.

You would need specialists to explore and to drill wells. Other experts to furnish pumping equipment, mechanical or hydraulic as determined by tests. Next, service machinery. Then the piping and storing of gas and oil—a whole industry within an industry. The pipe lines would end at a world of petro-chemistry where new processes unfold each month. To measure the full strength of your giant enterprise, you would want to consider the economics of changing natural gas into gasoline, or oil into gas, or perhaps liquefaction plants for stand-bys—most certainly, refineries for recovery of lighter hydrocarbons.

Companies, and even governments, are requesting estimates on just such total development today from Dresser Industries. We are the only company with production facilities and engineering knowledge spanning each stage of the oil industry from A to Z. That's why—The Biggest Jobs Are Going to Dresser. For development plans at any stage, domestic or foreign, regarding oil or gas equipment, write for special booklets to Dresser Industries, Inc., Terminal Tower, Cleveland, Ohio.

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THE ONLY COMPANY **DOING AN OVER-ALL JOB—**

From well to refinery
for the Oil Industry—
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DRESSER INDUSTRIES, INC.

TERMINAL TOWER • CLEVELAND 13, OHIO

XUM

SMOOTH FLOWING POWER

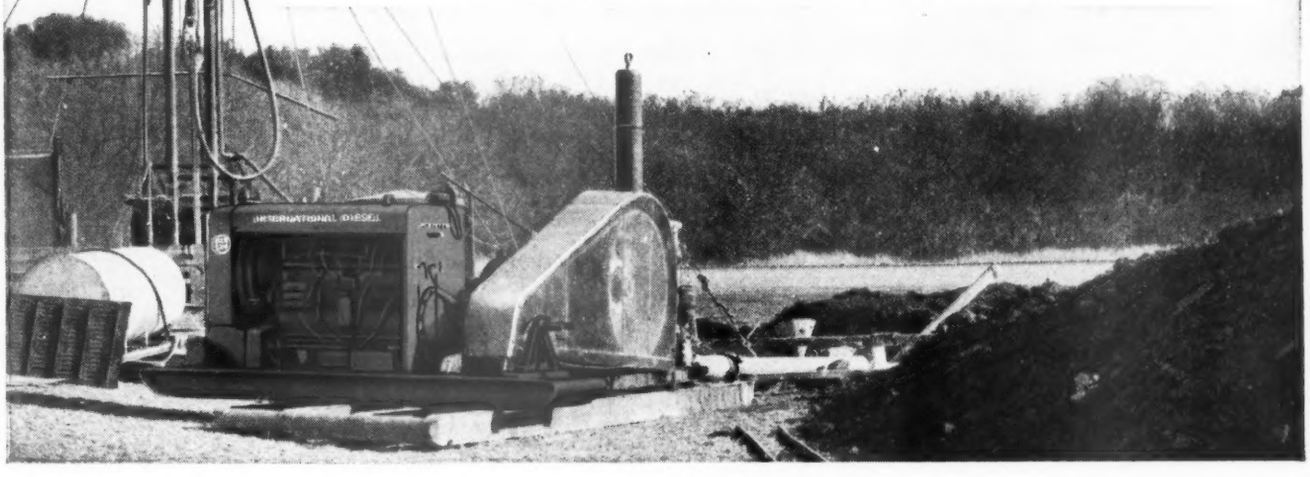
Your power problems are just water over the dam when your power is International. Smooth, rugged, International Power—diesel or gas—is unmatched for performance.

Mr. W. F. Russell of Russell and Russell, oil operators, producers and contractors of Gainesville, Texas, says of one of his International Diesel Power Units:

> **"This 180 h.p. UD-24 Diesel powers a 6 x 12 mud pump. To date we have drilled 15 wells with a total footage of 30,000 feet. No maintenance expense on this engine as yet. We find this International costs 33% less to operate than the butane engine it replaced. We also find that you have a vibrationless engine, the easiest to start of any engine we have ever used."**

Get smooth-flowing International power for your mud pumps, draw works, pump jacks—wherever you need power. See your International Dealer, Distributor or Supply House.

INTERNATIONAL HARVESTER COMPANY • Chicago



Hear James Melton and "Harvest of Stars" every Sunday — NBC

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POWER UNITS

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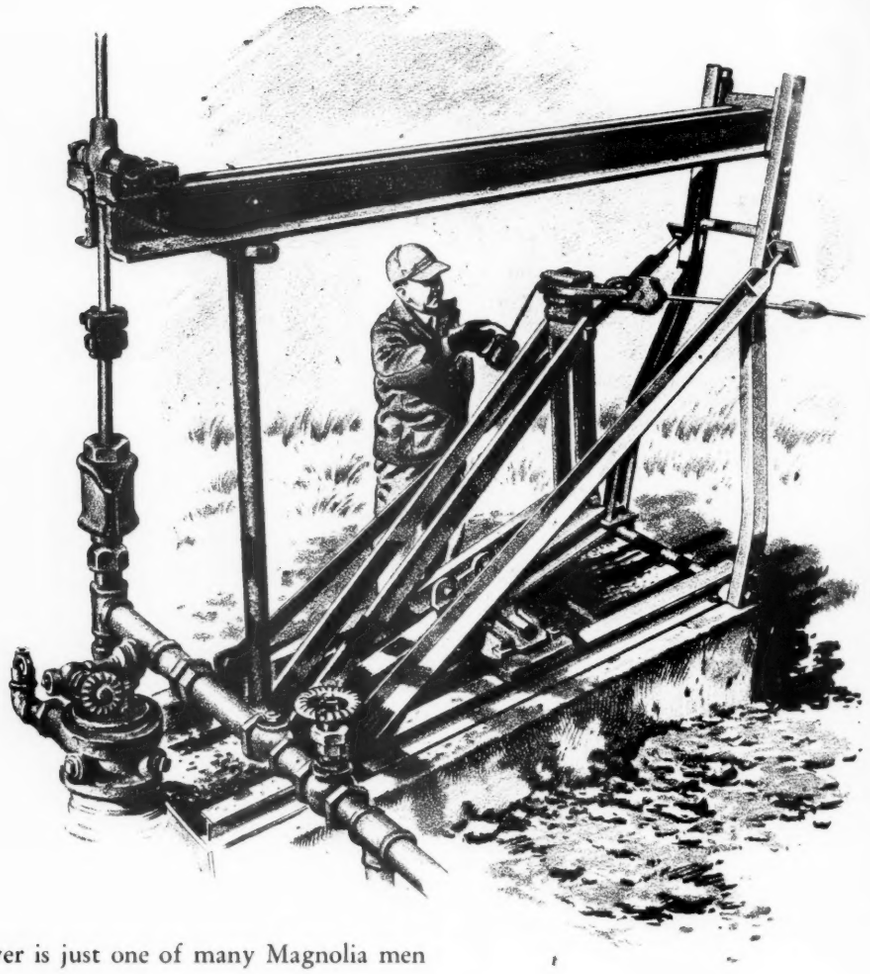
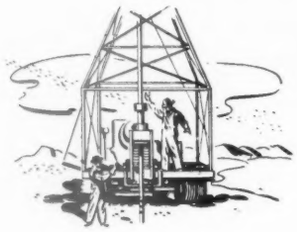
MAGNOLIA MEN AT WORK . . . TO REVIVE WORN-OUT OIL FIELDS



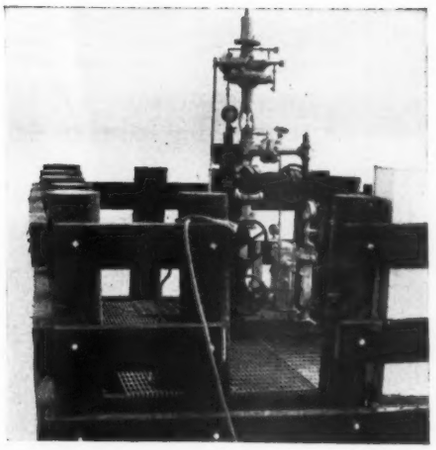


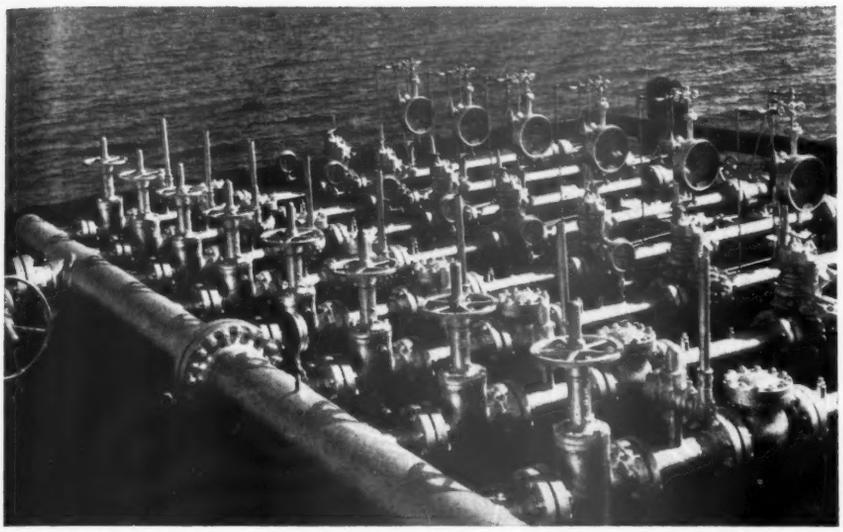
Earl Oliver is just one of many Magnolia men whose daily assignment is to put new energy into worn-out oil fields . . . to make them into better producers. Oil men call this "secondary recovery." • Largest of numerous Magnolia recovery projects in an eight-state area is the Seeley Lease in Greenwood County, Kansas. Before field work started, engineers carefully studied the oil pool or reservoir and examined "core samples" of oil sands. They had to determine how much oil remained in the ground, how much could be recovered and what it would cost. • By carefully following the directions of engineers, Magnolia production men inject either water or gas, or both, at designated points in the field. Sometimes new "input wells" are drilled. Injection of these fluids renews the energy of many a worn-out field by forcing oil into the wells. Water flooding alone, in many cases, has resulted in the recovery of an additional 3,000 to 3,500 barrels per acre . . . oil that would otherwise have remained in the ground. • Putting new "life" into old fields is just one of the many ways in which oil companies and operators are conserving oil resources . . . meeting your growing needs for more petroleum products.

MAGNOLIA PETROLEUM COMPANY

A SOCONY-VACUUM COMPANY

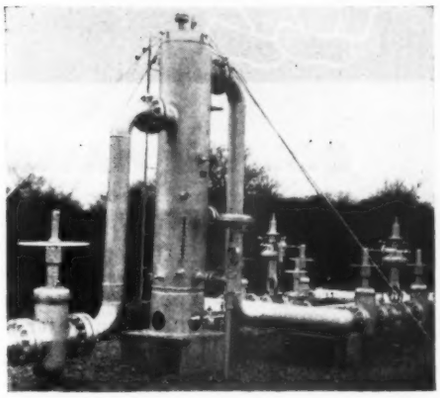
OFF-SHORE PRODUCTION AND GATHERING SYSTEM FOR NATURAL GAS



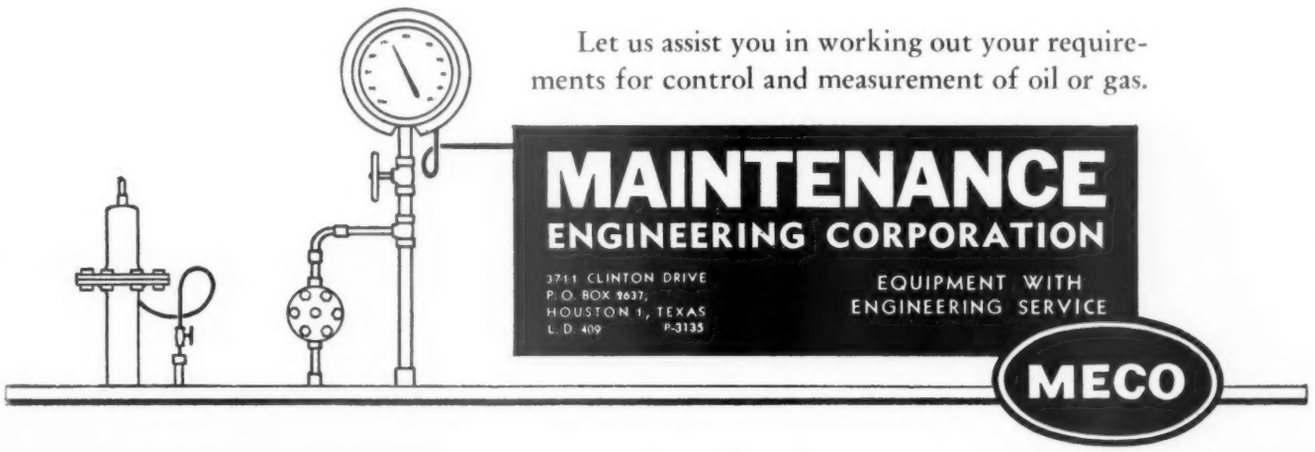


In the pictures:

1. A producing gas well, one of eight in this particular Marine project. MASONEILAN Regulators control the pressure from each well and will also automatically shut in wells if lines should break.
2. The Meter Station at center of field 12 miles out in bay. 'MAINTENANCE' Meter Runs with COMMERCIAL Orifice Fittings and READING-PRATT & CADY Check Valves.
3. Control and Measurement Station on main line near plant site. Equipped with PEERLESS Separator MASONEILAN Regulators and Meter Run by 'MAINTENANCE.'



This Texas Gulf Coast installation is furnishing gas to a major industrial plant. The offshore location offered unusual problems which were met by close cooperation by our engineers during the design, layout and installation of this system as well as during start-up period. In addition to the specialty equipment shown, system also includes NORDSTROM Plug Valves, EDWARD Meter and Gage Valves, VOGT Forged Steel Fittings and TUBE TURN Flanges and Welding Fittings—all stocked by 'MAINTENANCE' at Houston and COASTAL ENGINEERING at Harvey, La.



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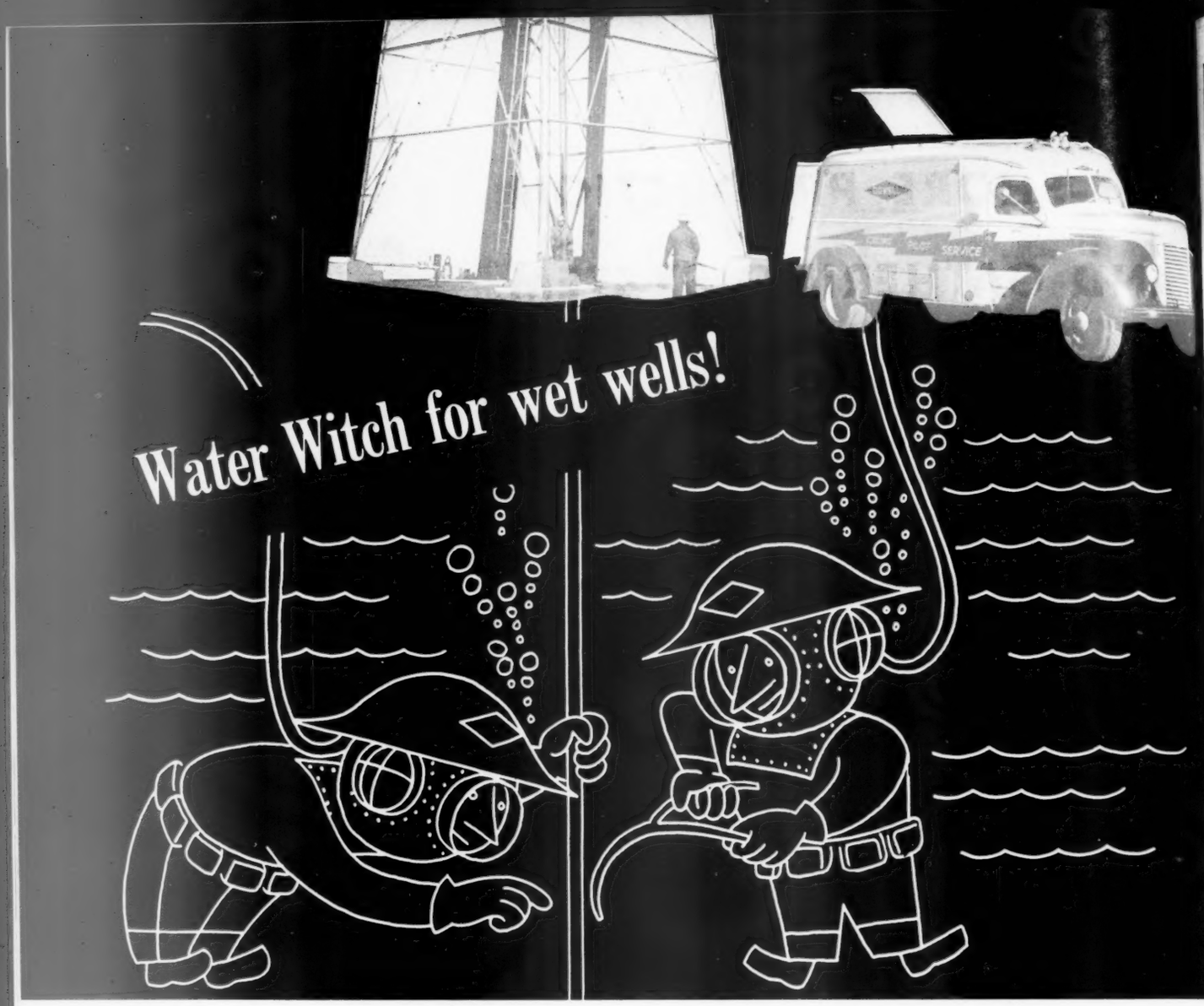


DOWELL WATER LOCATOR SURVEY gave positive and accurate determination of point of water entry

You can best shut off water in a well if you know where the water is coming from. For the location of points of water entry, look to the Dowell Water Locator.

"Water-witching" has been given scientific exactness by the Dowell Water Locator. One of the famous Dowell Electric Pilot Services, the Water Locator uses an electro-chemical reaction to produce surveys which are invaluable in workover and recompletion programs.

After the Water Locator has found points of water entry, Dowell Plastic Service has bee used to provide efficient shut-off. This was do in a 3670-foot well which was producing 90 water. A Dowell Water Locator Survey show the point of water entry at 3652 to 3665 fee Dowell Plastic was used to plug back to 3631 fee Result: *100% pipe line oil!*

Ask your nearest Dowell office about the Dow Water Locator and other Electric Pilot Service

DOWELL INCORPORATED
TULSA 3, OKLAHOMA
Subsidiary of The Dow Chemical Company

DOWELL
WATER LOCATOR

Ask your nearest Dowell station for complete information on these Dowell services and products: Acidizing, Electric Pilot Services, Plastic Service, Chemical Scale Removal Service for heat exchange equipment, Jelflake, Paraffin Solvents, Magnesium Anodes for corrosion control, and Bulk Inhibited Hydrochloric Acid.

"Petroleum Promotes Progress"

Look to DOWELL

FOR OIL INDUSTRY CHEMICAL SERVICE

THE PIONEER STILL IS PIONEERING

MUD is big business!

Not the kind of mud little Johnny tracks into the house on rainy days—but the special kind of mud that is so vital in drilling modern wells.

Last year the oil industry bought more than ten million dollars' worth!

That's Big Business, and it highlights the importance of pioneering work done years ago by National Supply in the development of better slush pumps . . . pumps that not only supply the necessary pressure under *accurate control,* but that also stand up under the severe punishment of millions of sharply abrasive particles in the mud. Today you can see "Ideal" Slush Pumps in every important oil field, working along with the other National Supply machinery and equipment which has won the confidence of oil men throughout the industry.

In addition to developing better pumps, National Supply has pioneered in a better way to *use* pumps. In "compounding" pumps, National Supply engineers have devised the first *practical* method of connecting two or more pumps in series so that they work smoothly together.

It is this kind of *practical* pioneering through which The National Supply Company has always paced the development of better products and services for the oil industry, and for many other industries as well.

THE NATIONAL SUPPLY COMPANY

Executive Offices: Pittsburgh, Pa.

NATIONAL OIL FIELD MACHINERY & EQUIPMENT

SPANG PIPE
SUPERIOR ENGINES

YOU CAN'T MEASURE A SUCKER ROD by appearance

Performance proves National's Extra Quality!

You'll never appreciate the enduring quality and rugged dependability of National Sucker Rods by examining them. BUT . . . watch them perform and you'll be convinced none better can be found anywhere . . . When you run a string of National Rods they're in for a long stay and they greatly reduce operating costs.

Consistent outstanding performance in oil fields everywhere results from the *extra quality* built into every National Rod. The steel, for example, is constantly checked by the Chemical and Metallurgical Laboratories to maintain specifications that provide strings of uniform strength. Precise manufacturing practices are observed in forging, normalizing and threading. And rigid inspection before shipment guarantees that each rod measures up to very exacting standards.

Write for descriptive bulletin or consult your National Supply Store for advice concerning the rod best suited to your needs.

FOR DRILLING ★ *THE INDUSTRY'S MOST COMPLETE*

GRADE 30

Recommended for light and medium pumping loads where fluids are non-corrosive. It may be used with fair success in the presence of small quantities of hydrogen sulphide. Available in double-pin type.

GRADE 40

Will handle heavy pumping loads where fluids are non-corrosive and there are no appreciable quantities of sulphides. Made in double pin type only.

GRADE 81

Will handle heavy pumping loads where corrosion is bad but sulphides not severe. Made in double pin type only.

GRADE 91

Recommended for heavy corrosive and sulphide pumping loads under severe conditions. Made in double pin type only.

THE NATIONAL SUPPLY COMPANY

GENERAL SALES OFFICE: TOLEDO, OHIO

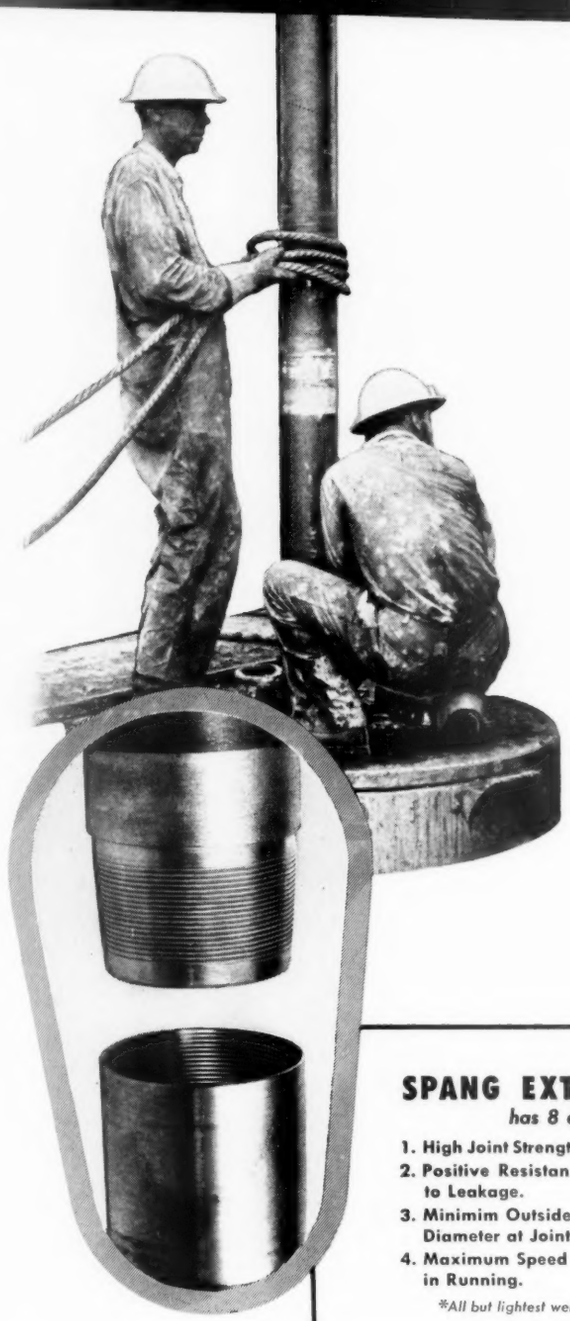
DIVISION OFFICES: CASPER; FT. WORTH; PITTSBURGH; TULSA; TORRANCE.
EXPORT: NATIONAL SUPPLY EXPORT CORPORATION, 30 ROCKEFELLER PLAZA, NEW YORK, N. Y., U.S.A.; RIVER PLATE HOUSE, 12 SOUTH PLACE, LONDON E.C.2.

THE NATIONAL SUPPLY COMPANY NSCO — NATIONAL BLUE PRODUCTS

LINE OF OIL FIELD EQUIPMENT ★ FOR PRODUCTION

There's no Detour FOR TOOLS ...IN SPANG

EXTREME LINE CASING



● The Spang Extreme Line Casing joint is streamlined on the inside which helps tools get to work without delay. There is no big recess such as found between the pipe ends of ordinary casing . . . instead there is just a narrow streamlined groove. Consequently, there are no detours to provide restrictions or obstructions for bits, swabs, packers or other tools to hang up going in or coming out of the hole.

What's more, the streamlined bore slows down corrosion. It reduces turbulence at the joint which prevents protective films from being washed away and exposing fresh metal to attack.

Write us for complete details about Spang Extreme Line Casing or contact one of our field engineers direct or through a nearby National Supply Company store for expert help on all your casing problems.

SPANG EXTREME LINE CASING

has 8 distinctive advantages

1. High Joint Strength.
2. Positive Resistance to Leakage.
3. Minimim Outside Diameter at Joint.
4. Maximum Speed in Running.
5. Streamlined Exterior Contour.
6. High Resistance to Damage.
7. *Internal Flush Joint
8. 50% less threaded connections than A.P.I. Casing.

*All but lightest weights of a size will pass the A.P.I. drift.

THE NATIONAL SUPPLY COMPANY

SPANG-CHALFANT DIVISION, PITTSBURGH, PA.

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THE NATIONAL NSCO SUPPLY COMPANY — NATIONAL BLUE PRODUCTS

★ THE INDUSTRY'S MOST COMPLETE LINE OF OIL FIELD EQUIPMENT ★

XUM

REMOTE CONTROL
made simple, safe and sure

Promoting increased efficiency in valve operation

Panelboard operation of distant valves is becoming more and more an essential convenience and a factor of greater operating safety. One central operator can be responsible for any number of valves. There's no delay in going from valve to valve, some of which may be located at great distance. Emergency shut-offs and frequent routine operation can be instantly made with Nordstrom cylinder operated valves. Their lubricated plug and simple, quarter-turn make them best adaptable to cylinder operation. Can be operated with air, gas, oil or water. In many cases, fluid in the main piping system may be used as the operating medium. Automatic shut-off for river crossings and main transmission lines is provided. Cylinder operating pressures range from 50 to 200 lb. When planning future installations, give consideration to panelboard control for increased efficiency and saving in man-hours. Nordstroms identify well-engineered plants.

Nordstrom **LUBRICATED VALVES** *Cylinder operated*

XUM

NORDSTROMS IDENTIFY
WELL-ENGINEERED PLANTS

•

KEEP UPKEEP DOWN

Use only genuine Nordcoseal lubricants

Head off shut-off worries

When you want a tight shut-off all along the line you have complete assurance with Nordstrom valves. You don't have to worry about dust, abrasives or suspensions in the line fluid interfering with valve closure. The Nordstrom rotary plug, sliding on its protected lubricant seat, closes sleeve-like instead of depending upon an imposed thrust against an exposed seat. Pressurized "Sealdport" lubrication surrounding each port prevents leakage internally and externally. This is valve engineering at its best; valve operation so positive, so sure, that no other means of line control can equal it.

Nordstrom

LUBRICATED ROCKWELL VALVES

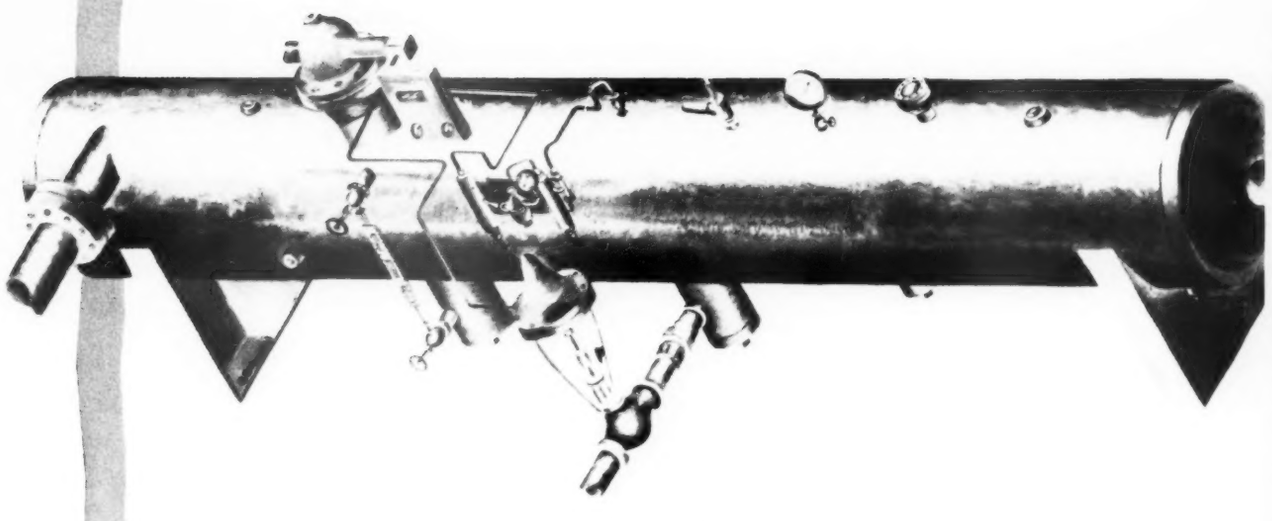
Sealdport Lubrication

NORDSTROM VALVE DIVISION—*Rockwell Manufacturing Co.*— 400 No. Lexington Ave., Pittsburgh 8, Pa.

Atlanta • Boston • Chicago • Houston • Kansas City • Los Angeles • New York • Pittsburgh • San Francisco • Seattle • Tulsa • and leading Supply Houses

Export: Rockwell International Corporation, 7701 Empire State Bldg., New York 1, N. Y.

XUM



Why is it horizontal?

It's a new BS&B product . . . the horizontal oil and gas separator. Up to now BS&B has built only vertical separators, but there are many good reasons for now adding the horizontal type. Here's why . . .

(1) A horizontal separator of the same diameter can handle more gas than a vertical separator.

(2) High gravity condensate and high pressure gas can be separated faster in the horizontal type.

(3) On the basis of capacity per dollar, the horizontal type is thriftier at pressures of 500 p.s.i. and higher.

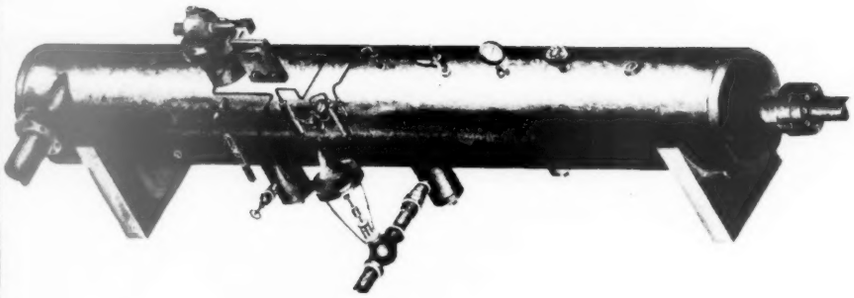
(4) A horizontal separator is easier to install and hook up.

That's why the horizontal separator "belongs" . . . why it now joins BS&B's growing family of better made products for industry.

BLACK, SIVALLS & BRYSON, INC

XUM

One, two, or three-stage separation with BS&B's new horizontal separators!



Here at last! BS&B brings you one, two, or three-stage separation with a brand new line of horizontal oil and gas separators. Two or three stage separation units are now available as separate vessels or skid-mounted as one unit. Meter runs for one, two or three stages can be mounted alongside the vessels on skids with flow recorder and other instruments mounted in a housing at one end of the skid.

The three stage unit is available with the second and third stages in an integral shell, ten feet long or more. The second stage operating at 250 psi maximum and the third stage operating at 125 psi maximum. The two stage unit will have a second stage with 125 psi maximum working pressure and shell length equal to that of the first stage and same diameter if desired. The second stage, however, can usually be a smaller vessel, minimum diameter of 12 inches.

The new BS&B Horizontal Separator employs torque-tube level controls with pilot controlled oil valves. The standard unit is equipped with gauge glass fittings, pressure gauge, pop valve, companion flanges, gas regulator, drip pots, oil valve and level control. The units are designed to handle fluids free of sediments. Any inquiries should include data on amount of liquid to be expected and the first stage pressure.

BS&B HORIZONTAL SEPARATOR MODELS

Size	Working Presure	Gas Capacity MMSCFD	Liquid Capacity Bbls/day
12" x 10'	500	5.4	540
16" x 10'	500	8.0	800
20" x 12'	500	16.0	1600
24" x 15'	500	22.5	2250
30" x 20'	500	40.5	4050
12" x 10'	1000	9.0	900
16" x 10'	1000	13.5	1350
20" x 12'	1000	22.0	2200
24" x 15'	1000	36.0	3600
30" x 20'	1000	63.0	6300
12" x 10'	1500	10.0	1000
16" x 10'	1500	16.2	1620
20" x 12'	1500	28.0	2800
24" x 15'	1500	40.5	4050
12" x 10'	2000	12.0	1200
16" x 10'	2000	18.0	1800
20" x 12'	2000	28.0	2800
24" x 15'	2000	45.0	4500

BS&B is prepared to design and build any special unit . . . a larger one or one to fit special requirements! Contact your nearest BS&B Sales Engineer TODAY. Or write to:

BLACK, SIVALLS & BRYSON, INC.

OIL FIELD EQUIPMENT DIVISION

Power & Light Bldg. **Kansas City 6, Missouri**

XUM

SUPPLYING THE OIL INDUSTRY
WORLDWIDE

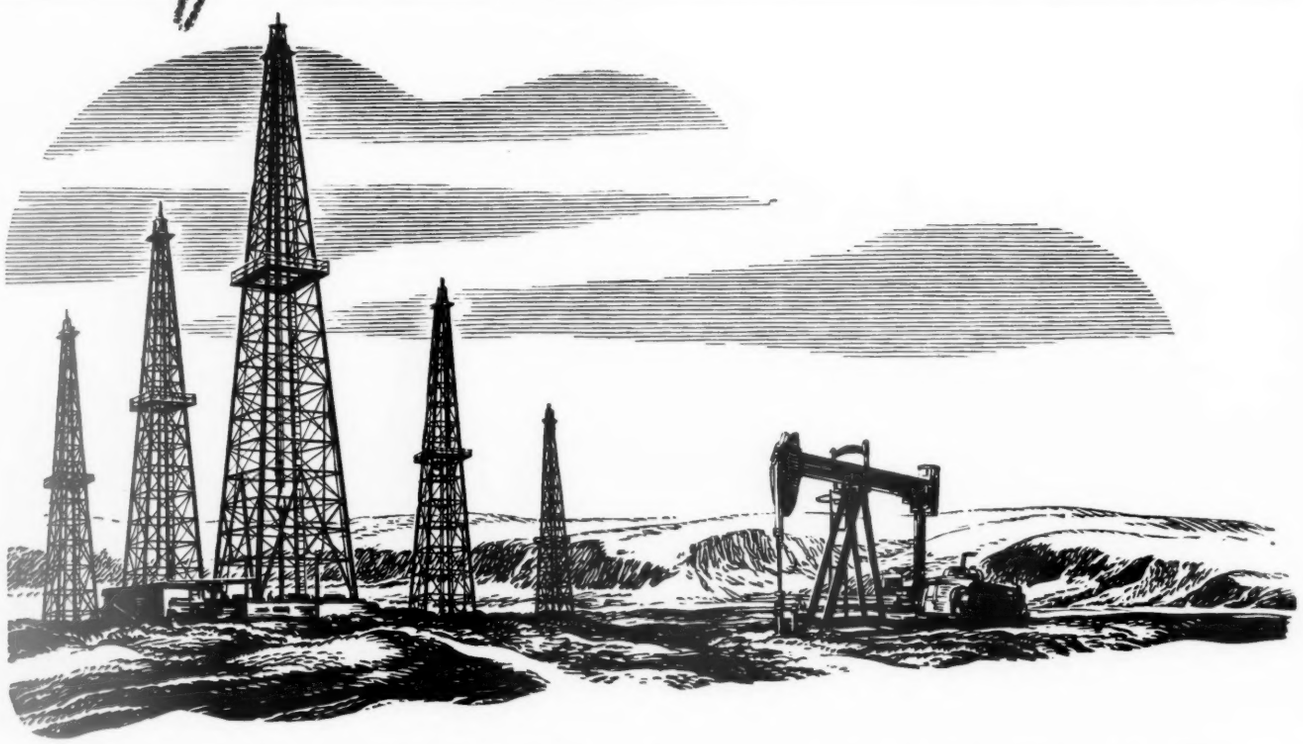
A Complete Line of Proven Eqiupment for the Petroleum Industry

Wherever your rigs are operating—either in domestic or foreign fields—we have exceptional and complete facilities for filling your requirements with superior, proven equipment. Our export division is staffed with seasoned personnel, thoroughly familiar with all material needs in the Petroleum Industry and ready to help with your foreign equipment problems. Our Service Engineers are available in foreign and domestic fields to assist you.

MID-CONTINENT
Supply Company

Executive Offices—Mid-Continent Building—FORT WORTH, TEXAS
NEW YORK LOS ANGELES

Let us solve your problem: **Your tough**



Compare TORRINGTON BEARING performance and service life with the best you've ever had—in your own equipment under your own control

We want to show you *why* Torrington Bearings are finding wider use and preference for oil field machinery. There's a reason: *proved performance.*

It's performance demonstrated by years of service in drilling rigs, slush pumps, unit pumpers, draw works, rotary tables, transmissions, servicing masts, drives, and other heavy-duty equipment. It's performance based on engineered capacity, ruggedness, precision and metallurgical properties that mean longer service life in the most exacting application.

You can prove it to your own satisfaction. Arrange with a Torrington service engineer to run a performance test on Torrington Bearings in your toughest anti-friction bearing application.

TORRINGTON

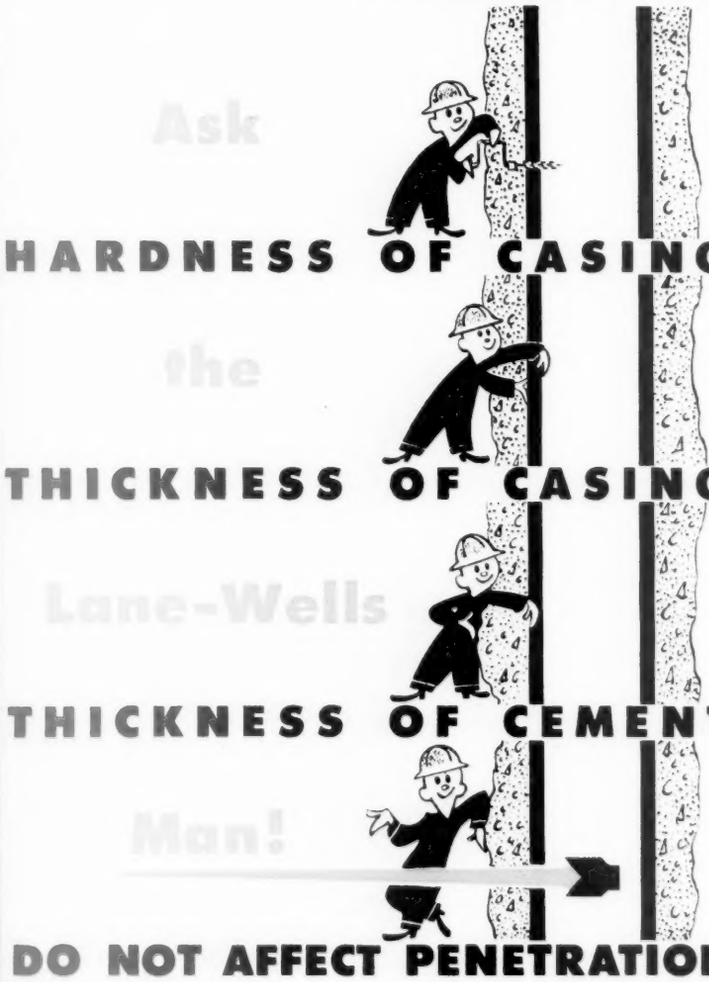
SPHERICAL ROLLER • TAPERED ROLLER • NEEDLE

"FOR ECONOMY AND LONG LIFE
YOU CAN DEPEND ON A
HUGHES *Seal Grip* TOOL JOINT"

HUGHES TOOL COMPANY HOUSTON, TEXAS
Standard of the Industry

FOR YOUR TOUGH PERFORATING JOBS

KONESHOT PERFORATING

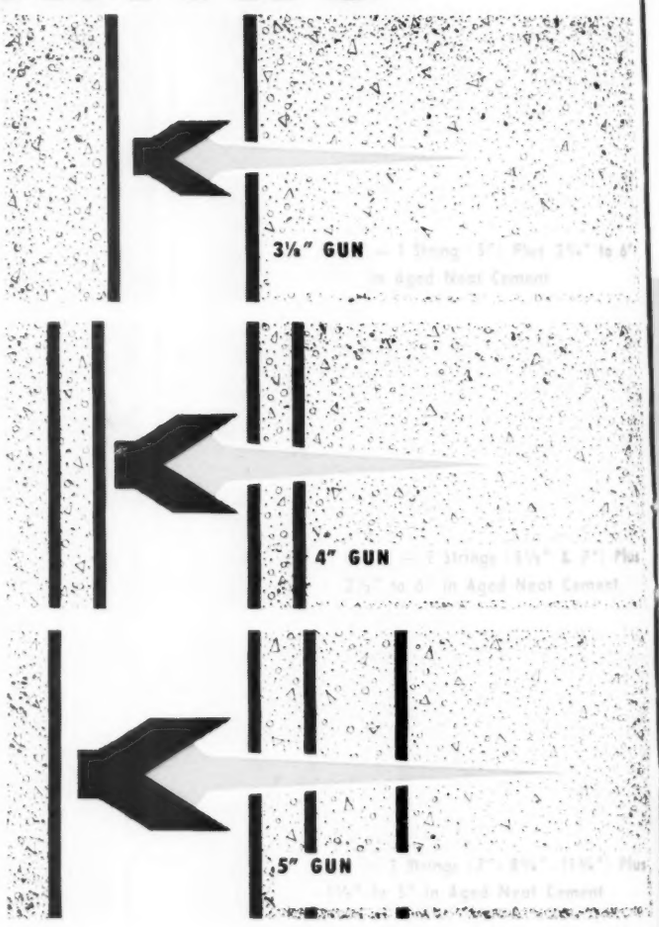


HARDNESS OF CASING

THICKNESS OF CASING

THICKNESS OF CEMENT

DO NOT AFFECT PENETRATION



LANE WELLS

TECHNICAL OILFIELD SERVICES

LOS ANGELES — HOUSTON — OKLAHOMA CITY

GENERAL OFFICES, EXPORT OFFICES & PLANT 5610 SO. SOTO ST., LOS ANGELES 11, CALIFORNIA

LANE-WELLS SERVICE AND PRODUCTS ARE AVAILABLE THRU PETRO-TECH SERVICE CO. IN VENEZUELA

"Oilwell" TC-8B
Light-Duty Pumping Unit

FROM the smallest, shallow-well pumping unit to large models for heavy-duty production assignments, "Oilwell" Pumping Units are scientifically designed to give trouble-free performance, long life and economical service.

Advantages of "OILWELL" Pumping Units

Easy and effective counter-balancing—"Oilwell" Type "B" adjustable counterweight cranks are standard equipment on all heavy-duty units and the TC-17C medium-duty unit. All other medium-duty units have slab-type counterweight cranks and are also equipped for beam counter-balancing. The light-duty units are counter-balanced by means of beam weights. It is necessary to purchase only enough counterweights to suit individual well conditions.

Wide speed range — Inherent stability, ample strength throughout, and accurate counter-balancing make it possible to operate "Oilwell" pumping units safely over a wide speed range.

Wide selection of stroke lengths — "Oilwell's" self-aligning crank-pin bearings and knuckle-joint pitmans facilitate adjusting stroke lengths in the field.

Adaptable to temporary or permanent foundations — The strength and rigidity of "Oilwell" pumping units make them adaptable to temporary wood foundations or permanent foundations which require a minimum of concrete.

Portable—Deep structural-steel base beams facilitate field-transportation and installation. The wide base construction minimizes the tendency to turn over when loading or unloading.

Adaptable to a variety of prime movers—Universal slide rails make it easy to install various types, makes and sizes of prime movers. The fly-wheel-type pulley smooths out torque peaks and prevents excessive load fluctuations.

Long life and low upkeep . . . result from numerous outstanding construction features, including a lubrication system that makes maintenance foolproof and easy. From only three locations a maintenance man with a grease gun can grease pack every bearing quickly.

Wide range of sizes and types — The wide selection of "Oilwell" Pumping Units is made possible by the interchangeability of gear boxes and other major parts. This provides maximum economy for a great variety of pumping requirements.

For True Operating Economy

select the "Oilwell" Pumping Unit that is designed to meet your well requirements

"Oilwell" TC-33HB
Heavy-Duty Pumping Unit

Unit	Polished-Rod Load Capacity A.P.I. Rating pounds	Peak-Torque Capacity at 20 s.p.w. A.G.M.A. inch-pounds
Light-Duty Twin Crank		
TC-5C	5,100	24,100
TC-6	6,900	32,200
TC-8B	9,500	45,400
Medium-Duty Twin Crank		
TC-12C	10,000	60,500
TC-17C	12,800	85,600
Heavy-Duty Twin Crank		
TC-23	17,400	120,600
TC-28	17,400	145,700
TC-33HB	21,000	166,700

The "Oilwell" line is supplemented by a wide selection of surface equipment and production supplies.

OIL WELL SUPPLY COMPANY

Branches Serving All Oil Fields

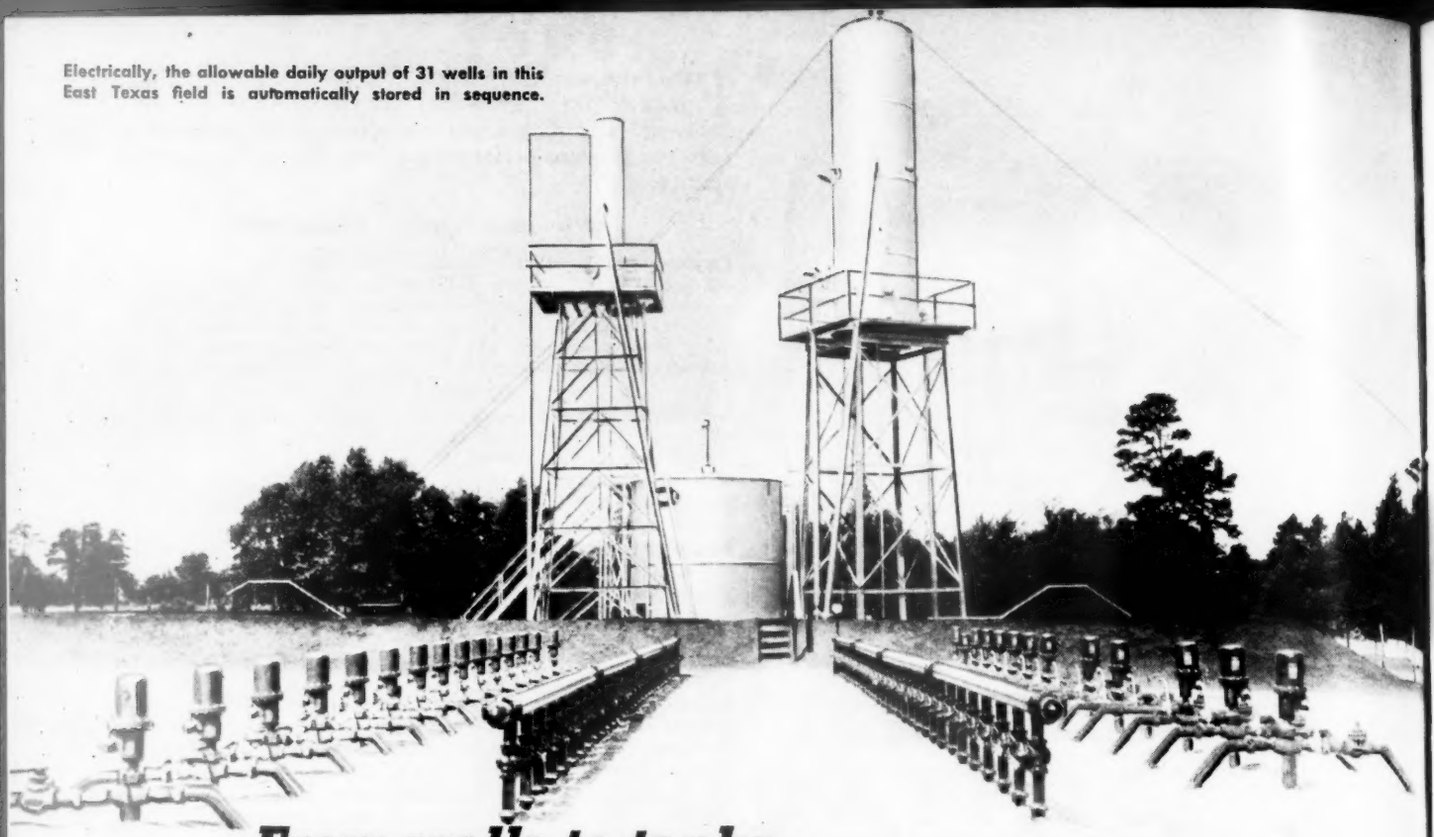
Executive Office — DALLAS, TEXAS
Export Division Office —
30 ROCKEFELLER PLAZA
NEW YORK 20, N. Y.

Division Offices — CASPER, WYOMING
COLUMBUS, OHIO . . . DALLAS, TEXAS
HOUSTON, TEXAS . . . TULSA, OKLAHOMA
LOS ANGELES, CALIFORNIA

USS "OILWELL"

UNITED STATES STEEL

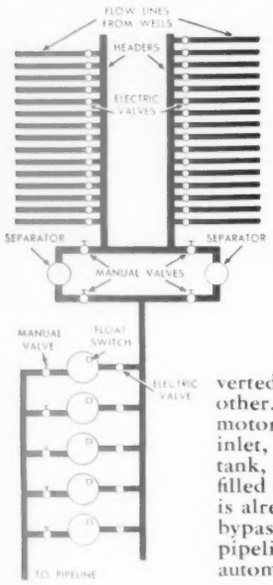
XUM



Electrically, the allowable daily output of 31 wells in this East Texas field is automatically stored in sequence.

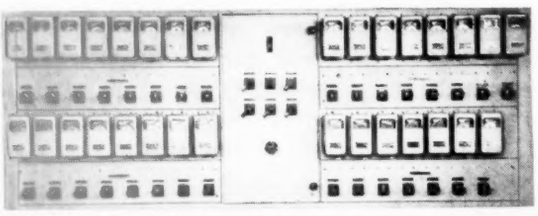
From wells to tanks– AUTOMATICALLY!

Another example of General Electric oil field electrification!



THIS IS THE WAY IT WORKS!

As this schematic layout shows, all well lines are opened and closed by motor-driven hydraulic valves, actuated by time switches. Any well can also be flowed by a manual valve in parallel with automatic valve. After passing through headers and separators, well flow is automatically diverted from one storage tank to another. This is done by means of a motor-operated valve in each tank inlet, a special float switch atop each tank, and a control panel. Tanks are filled in sequence, with any tank that is already filled or on pipeline being bypassed. If all tanks are full or on pipeline, the system shuts itself off automatically.



HERE'S THE HEART OF THE SYSTEM! This G-E central control panel, which governs the lease's entire producing schedule, contains master switch, manual tank-valve switches, and sequence selector. Flanking it are 31 G-E time switches and manual switches for all wells. Ample room at the bank of the panel makes for easy inspection and repair.

Here is just one of many illustrations of the savings that electrification can bring to oil production. In the case of this East Texas oil field, an electrically-controlled system utilizing General Electric control throughout now makes possible *automatic* control of the allowable production of 31 flowing oil wells and a battery of five storage tanks!

By eliminating manual operations, this electrified system reduces necessary walking to and from wells, since it requires little or no attention by the operator. This frees the operator for other duties, helps cut lease operation costs.

HOW CAN *YOU* CUT COSTS—ELECTRICALLY?

Whether your job is drilling, well pumping, or pipe-line pumping, there are plenty of ways in which electrification can help you do it more efficiently, more economically. They're described in Bulletin GES-3485, "More Oil at Less Cost—Electrically." Send for your copy today.

A MOVIE WORTH SEEING!

It's "Lease on the Future", a motion picture on oil field electrification, in full color and sound. Ask your nearest G-E office about having it shown to your organization.

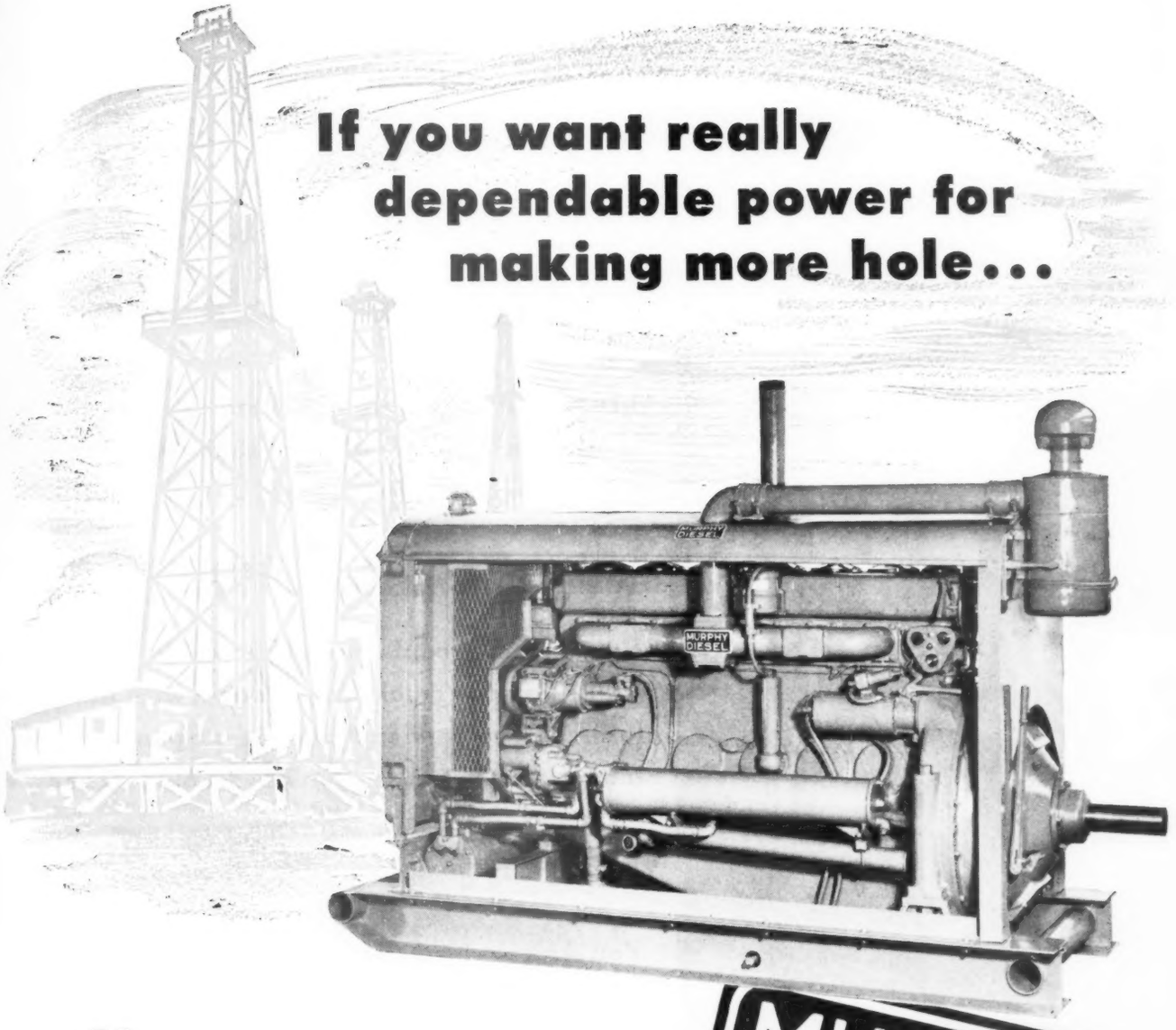
More Power to America

Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

XUM

If you want really dependable power for making more hole...



YOU'LL hit pay faster with power that doesn't konk out when the going gets tough. Murphy Diesels are rugged heavy-duty engines built to stand the gaff of 24-hour-a-day service without whimpering. Murphy Diesels will make more hole per gallon of fuel, too, because they are "True" diesels. Rugged construction and full rated output at 1200 RPM reduces wear and tear on the engine. Unit fuel injection system minimizes down time . . . Murphy Unit Injectors require less attention and on the rare occasions when it is necessary, can be removed and replaced in two minutes. It all adds up to long, dependable service with a minimum of trouble. Ask your Murphy Diesel Dealer to tell you the whole story or write direct.

MURPHY DIESEL

MURPHY DIESEL COMPANY
5343 W. Burnham St., Milwaukee 14, Wis.

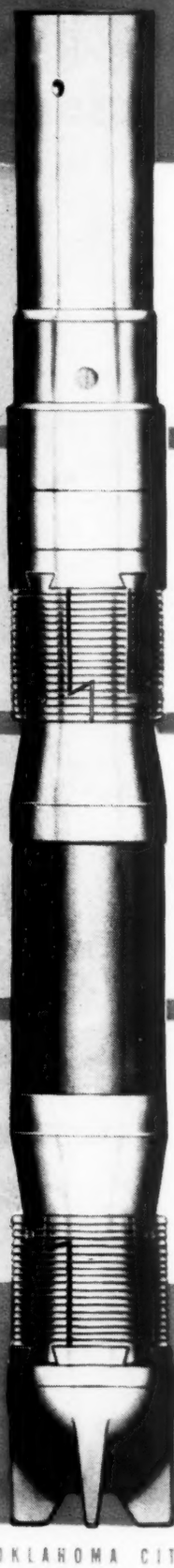
Heavy duty power

for the oilfields

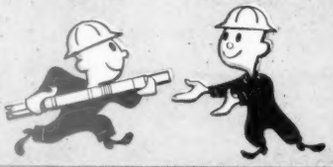
Murphy Diesel Engines and Power Units for drilling and pipeline pumping, 90 to 190 H.P. Diesel-Electric generating Sets 60 to 116 K.W.

FACTORY BRANCH—Sales, Parts and Service: 113-117 South Elwood Street, Tulsa, Oklahoma

It's Easy · · to use LANE-WELLS DRILLABLE BRIDGING PLUGS!



GET IT!



Lane-Wells Drillable Plugs are available in most sizes, from any one of more than 40 Lane-Wells branches. Quick delivery—

It's Easy!

SET IT!

Run it on the regular conductor cable of the Lane-Wells Service Truck, on your own wire line, or on tubing—if you prefer. It's quick—no pumps, no waiting for cement to set—you have a plug right away.

It's Easy!

FORGET IT!

You *know* you have a positive, pressure-tight packoff, right where you want it—a plug that will outlast the casing in permanent installations.

It's Easy!

OR DRILL IT

Lane-Wells Drillable Bridging Plugs can be knocked out or drilled up in from 2 to 6 hours, with either rotary or cable tools. One good rock bit usually does the whole job.

It's Easy!

. . . Ask the Lane-Wells Man for the full story!

LANE WELLS

TECHNICAL OILFIELD SERVICES

LOS ANGELES — HOUSTON — OKLAHOMA CITY

GENERAL OFFICES, EXPORT OFFICES & PLANT
5610 SO. SOTO ST., LOS ANGELES 11, CALIFORNIA

LANE WELLS SERVICE AND PRODUCTS ARE AVAILABLE THRU PETRO TECH SERVICE CO. IN VENEZUELA

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The full meaning for you of the

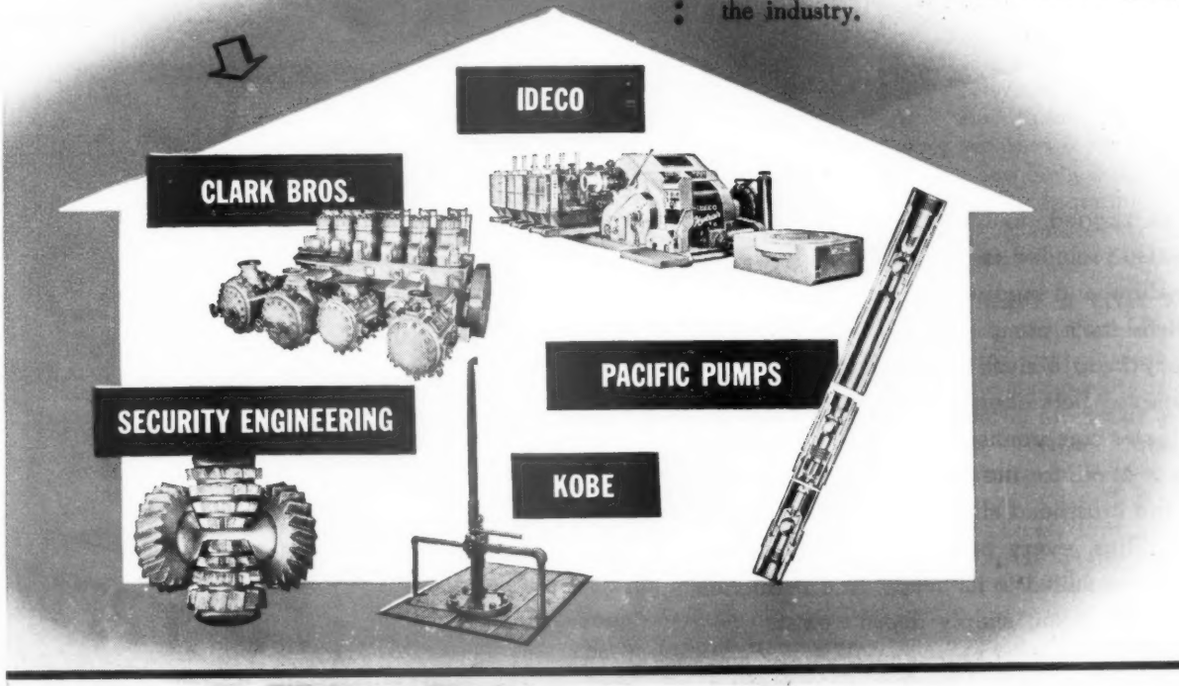
NEW COMBINED SERVICE DEPOT

Dresser Industries has established a new warehouse at Houston, Texas. It stocks equipment and replacement parts. It houses new offices for the convenience of the customers of:

You can get quicker service and simplified service from this one depot.

It is another example of Dresser policy . . . constantly expanding service facilities to keep pace with sales. When you think of Dresser Industries think of it as the company which recognizes that service to the oil industry is as important as new products to sell.

When you buy from any of the companies grouped within Dresser Industries, buy with assurance that your equipment is backed up with the most up-to-date service policy in the industry.



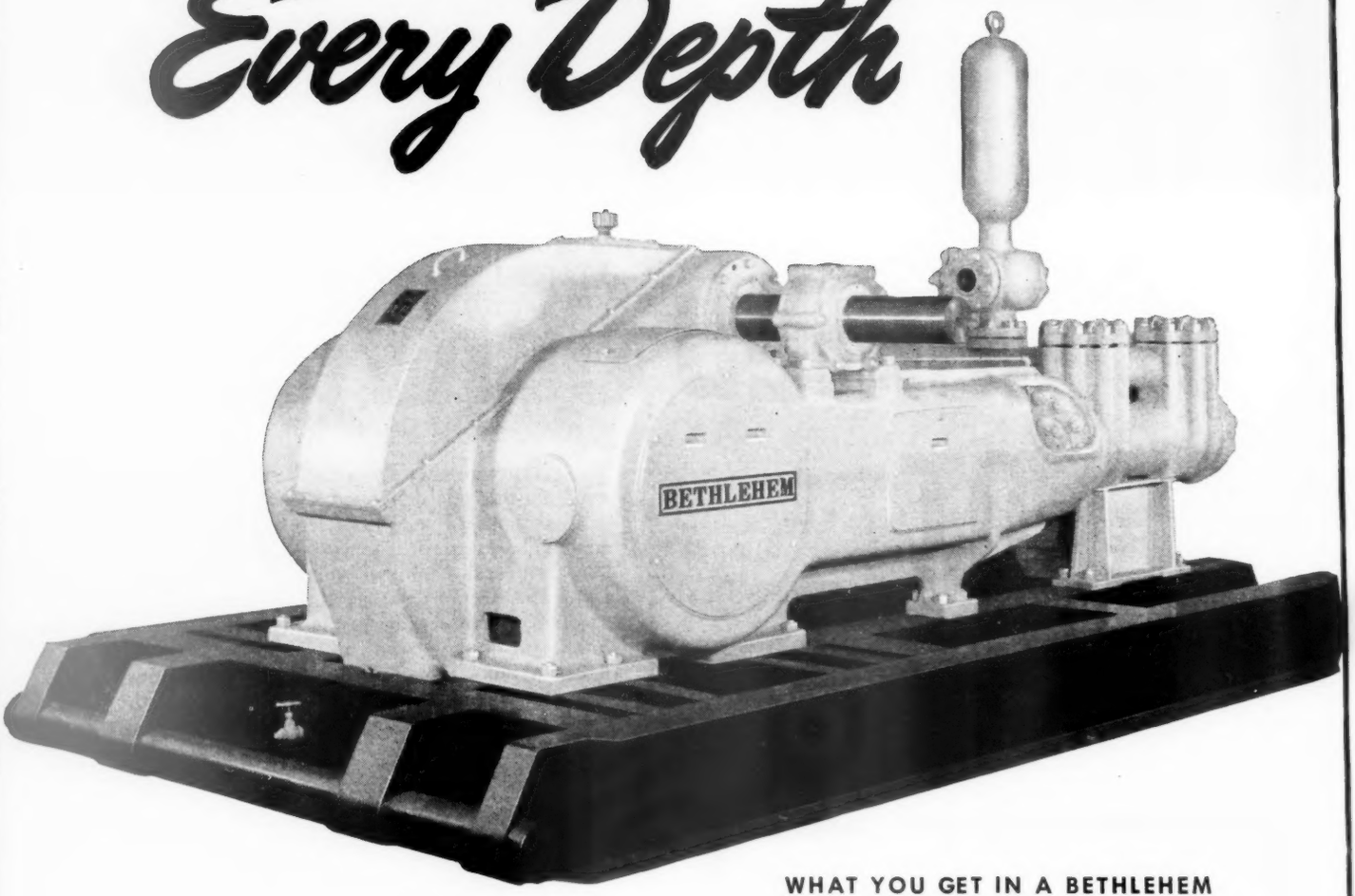
THE ONLY COMPANY **DOING AN OVER-ALL JOB—**

From well to refinery
for the Oil Industry—
From source to consumer
for the Gas Industry

DRESSER INDUSTRIES, INC.

TERMINAL TOWER • CLEVELAND 13, OHIO

BETHLEHEM BUILDS A PUMP FOR *Every Depth*



Yes, and the rugged, foolproof features of the big G-600 are also included in the smaller units—those used for shallow and medium depths. So no matter what size Bethlehem pump you need, you're sure of getting *everything* a slush pump should have.

One example: Bethlehem's tri-phase lubrication, which eliminates compromise oiling. For the gear and pinion, a bath of oil; for the roller bearings, pressure grease; for the crosshead slides and guides, a force-feed system. Thus, every part requiring lubrication gets the type best suited to its needs. In a Bethlehem pump, hit-or-miss oiling simply doesn't exist.

Makes sense, doesn't it? Our other features make sense, too. You'll find a dozen or so listed at the right.

BETHLEHEM SUPPLY COMPANY

General Offices: 21 E. Second Street, Tulsa, Okla.

Subsidiary of Bethlehem Steel Corporation

On the Pacific Coast Bethlehem Oil-Field Equipment is sold by Bethlehem Supply Company of California

BETHLEHEM STEEL

WHAT YOU GET IN A BETHLEHEM SLUSH PUMP

100% roller-bearing construction
One-piece gear-end frame with built-in alignment
Forged, heat-treated alloy-steel shafts
Double-extension pinion shaft
Forged, heat-treated alloy-steel cranks
Overhanging crank construction
Renewable crosshead slides and guides
Screw-type stuffing-box glands
All-steel fluid end
Double-packed Flint-Hard liners
Built-in telltale holes
Tri-phase lubrication

announcing

major improvements in Kelly drive bushing design

BJ

The new **AA** *shock absorbing*

KELLY BUSHING

...for square Kellys

DESIGNED FOR AVERAGE DEPTHS, this BJ Engineered Bushing has a heavier one-piece solid body. A Neoprene inner cushion (the same as in the earlier Type A) absorbs all shock as the rotating Kelly moves downward. New Slip Retaining Ring is simple in design and speeds up change-over of Slips through the range of square Kelly sizes from 3″ to 6″. New oil-resistant synthetic rubber Wiper fits at the base of the Kelly Drive Bushing.

EVEN AT THE HIGHEST speeds and pressures, the Type AA *beefed-up* Bushing feeds the Kelly evenly to help you maintain the desired weight on the bit. For longer life of Kellys, Subs, and Rotaries—it's the shock-absorbing quality that counts. Smoother in action, the BJ Kelly Bushing is recommended in the field by diamond coring, coring and fishing specialists.

LINERS OF BRONZE. Anti-friction material takes the wear as the Kelly rotates. *Renewable* and *reversible*, the Liners actually smooth and polish the Kelly. The life of an old Kelly is extended—a new Kelly remains smooth and polished, insuring additional years of dependable service. Even feed means longer bit life.

THERE'S A KELLY WIPER at the base of the body as a standard part of all sizes except the 6″. It keeps the mud out of the Bushing and out of the Rotary. Wash water is not needed . . . mud dilution is prevented. Be sure you get this improved Kelly Bushing for your rig. Liners, slips, and cushions are interchangeable between the Type A and the improved Type AA. Ask your BJ representative today about the improved Type AA *shock-absorbing* Kelly Bushing. **The best but most inexpensive** of all drive bushings.

Byron Jackson Co.

Since 1872

MAIN OFFICE AND PLANT

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Mid-Continent Office and Plant, Houston 1, Texas
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Branches in All Principal Oil Fields

BJ **means engineered oil tools**

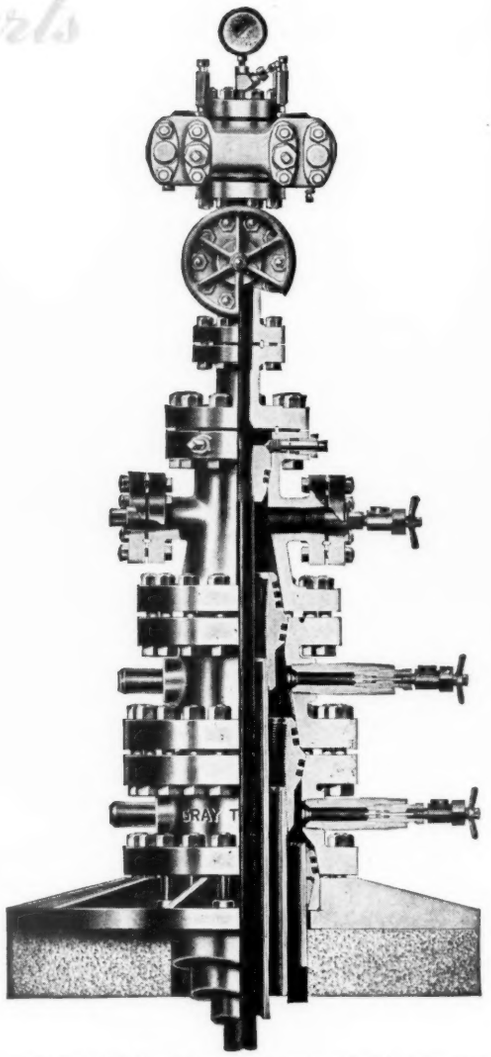
XUM

Fine Individual Parts

PLUS

COORDINATION

Painstaking care is exercised in the design and manufacture of the smallest part that goes into a Gray System of Well Control. Fine individual parts are engineered to give more strength with less weight. Operating conditions are studied for the locality in which the equipment is to be used. The entire sequence of operations is considered, and each step planned so that the equipment is coordinated into a unitary whole. This means fewer parts of higher quality, more strength with less weight, and greater value at less cost. For the operator, it means the highest degree of control, economy, flexibility and safety in the entire sequence of operations from drilling through producing the well.



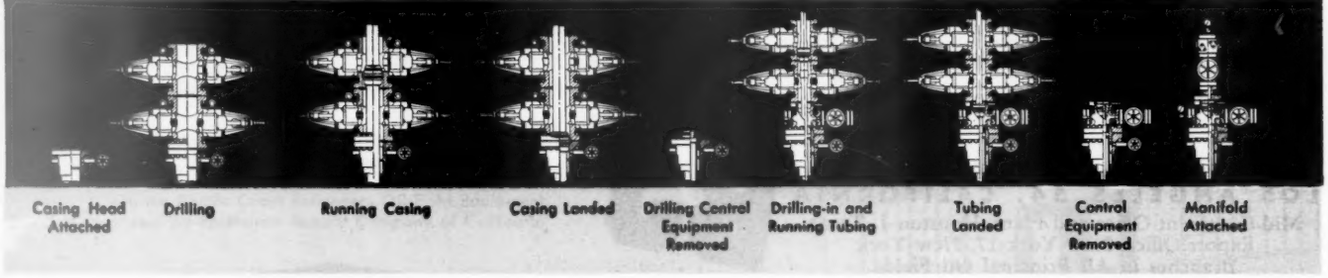
Complete Well Head Assembly equipped with Type 3170 Composite Manifold, Valve Removal, Installation and Renewal and Boll Weevil Casing and Tubing Hangers

GRAY TOOL COMPANY

HOUSTON

Rocky Mountain Representative: **CARL MOULDEN, P. O. Box 1890, Casper, Wyoming**

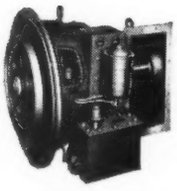
Export Representative: **DANIELS, BECKLEY & ASSOCIATES, INC., 30 Rockefeller Plaza, New York 20, N. Y.**



XUM

Softer Power for Harder Drilling

International Derrick and Equipment Company's Rambler Rig with H-40-D Hydrair Hoist shown on location.
Insert: Twin Disc Hydraulic Torque Converter (Lysholm-Smith type) mounted on H-40-D Hydrair Hoist.



On any location . . . in any formation . . . Ideco's Rambler Rigs have the power. It's soft power though, because it's transmitted through a Twin Disc Hydraulic Torque Converter which puts a hydraulic link in the hoist's power train.

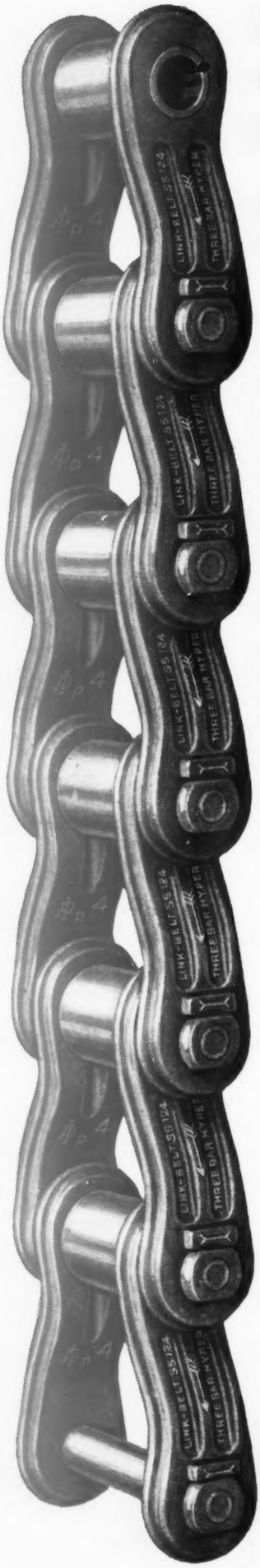
This hydraulic transmission multiplies engine torque . . . eliminates engine lugging and racing . . . keeps the engine in the hi-power range.

Twin Disc's Three-stage Converters automatically adjust to the most favorable engine speed . . . instantly give maximum speed for raising empty blocks and maximum pull for coming out. Smooth transmission of power through fluid protects the engine and hoist against shock, cushions acceleration for hoisting and rotating . . . ideal characteristics for swabbing and fishing.

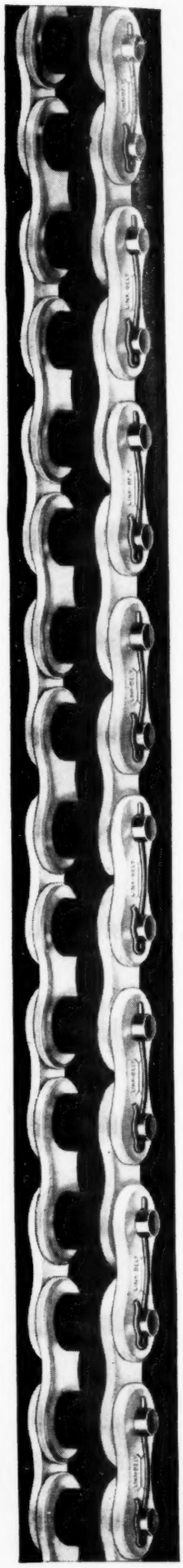
A pioneer in adapting torque converters to full oil field usage, Ideco has used Twin Disc Hydraulic Torque Converters for many years. For complete information on how Twin Disc Converters can smooth out your power transmission problems, write the Hydraulic Division for Bulletin 135-C. TWIN DISC CLUTCH COMPANY, Racine, Wisconsin (Hydraulic Division, Rockford, Illinois).

SPECIALISTS IN INDUSTRIAL CLUTCHES SINCE 1918

XUM



LONGER Chain Life
means
INCREASED Drilling Profits!



LINK-BELT
gives you 6 Simple Pointers on HOW to get
. . . *"longer service with less maintenance"*

Regardless of the make of your rig chains, follow these 6 simple Link-Belt suggestions and you'll increase your drilling profits!

1 — PROPER ALIGNMENT . . . check your sprockets *periodically* for alignment. Misalignment develops side-pull, concentrating the load on one side of sprocket teeth and chain. Such unbalanced load — indicated by wear on sprocket faces and inside surfaces of sidebars — shortens life of both sprockets and chains. Align properly and *save money!*

2 — PROPER ADJUSTMENT . . . run chains just a trifle more slack than a belt. Too much tension causes undue wear on chain and damaging friction on bearings. But a chain too slack will ride sprocket teeth and cause breakage, or even permit chain to jump off sprocket. Adjust properly and *save money!*

3 — PROPER LUBRICATION . . . use good, light mineral oil *only*. Faulty lubrication kills more chains than years of normal service. The presence of oil on outer chain surfaces does not necessarily mean that chain is properly lubricated. To be effective, the lubricant must penetrate between pins and bushings—constantly. To prevent corrosion, reduce friction and wear, lengthen chain and sprocket life . . . lubricate properly and *save money!*

4 — PROPER CLEANING . . . clean and lubricate chains *frequently* — remove chain occasionally for more thorough cleaning. Before replacing in service, *always* dip the chain in good, light lubricating oil — and *turn* over *slowly* until lubricant has penetrated all parts. Keep mud and dirt away from chains — prevent corrosion. A good rule: remove and *thoroughly clean* chains every time you move rig. Clean properly and *save money!*

5 — PROPER SPROCKETS . . . inspect sprocket teeth *regularly*. Worn teeth damage chain. Slightly worn teeth can be improved by grinding. But if teeth are broken or badly worn, sprocket should be replaced immediately. Another good rule: never install new chain on worn sprockets. Keep sprockets in proper condition and *save money!*

6 — PROPER CHAINS . . . *selection* of proper chains — as well as sprockets — is the final secret to Link-Belt's *"longer service with less maintenance"*. Drives must be suitable to power transmission required. Chain should be inspected regularly. If these 6 pointers are observed, you'll seldom replace Link-Belt chains. Use Link-Belt chains and sprockets — and *save money!*

• If you want further advice on chain and sprocket care, please write us. And if you want *"longer service with less maintenance"* . . . if you want to increase your drilling profits . . . *always specify* LINK-BELT chains and sprockets.

LINK-BELT COMPANY

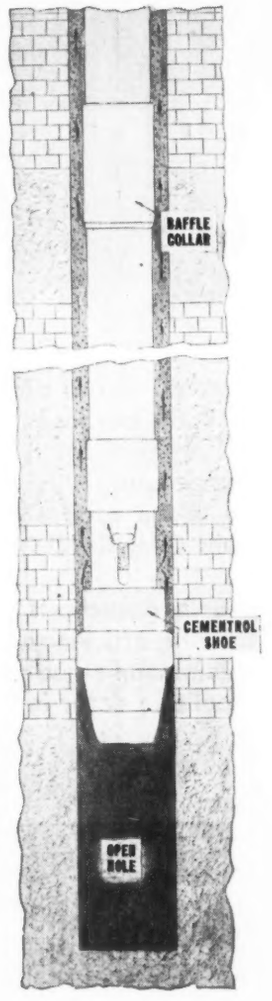
Indianapolis 6, Dallas 1, Houston 3, Los Angeles 33, Kansas City 6, Mo., New York 7, Toronto 8.
Distributors in all fields. 11.508

LINK-BELT
CHAINS AND SPROCKETS
A Type for Every OIL INDUSTRY SERVICE

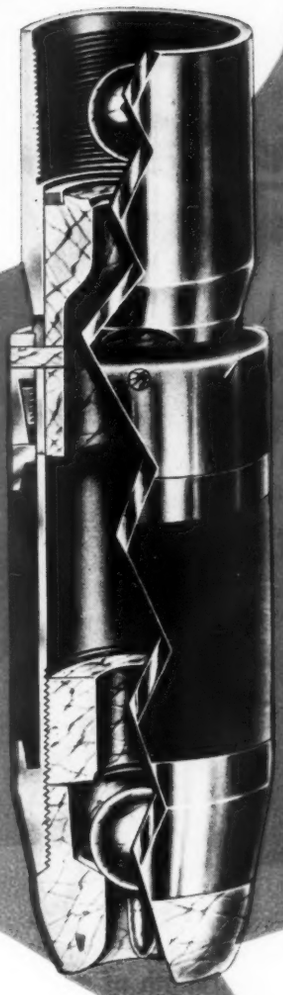
Cementrol

your solution

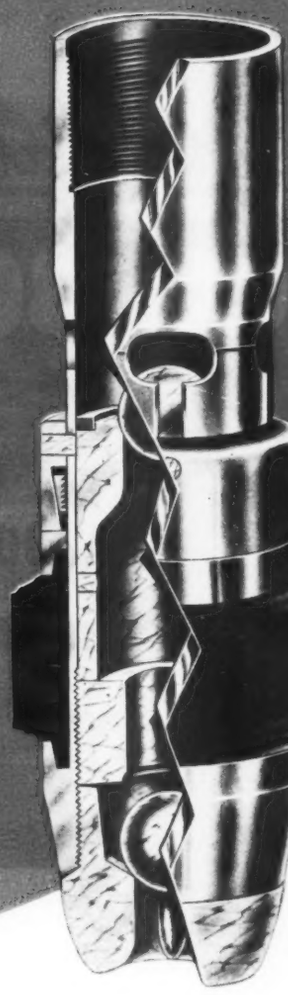
TO A SPECIFIC CEMENTING PROBLEM



Here's how CEMENTROL accomplishes its purpose



Running-in position . . . serving only as a float shoe.



Position after expansion by pump pressure.

The CEMENTROL Principal was developed to supplant conventional methods and to provide a means of overcoming well completion difficulties caused by cement intrusion into the open oil or gas bearing formation below the casing seat.

FIELD DESIGNED . . . FIELD TESTED . . . FIELD APPROVED . . . and for five years has been considered standard equipment in areas where it is imperative that exposed formations be protected from cement contamination.

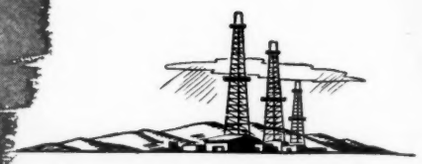
Buy CEMENTROL ". . . THROUGH YOUR SUPPLY STORE"

LARKIN

. . . Through Your Supply Store

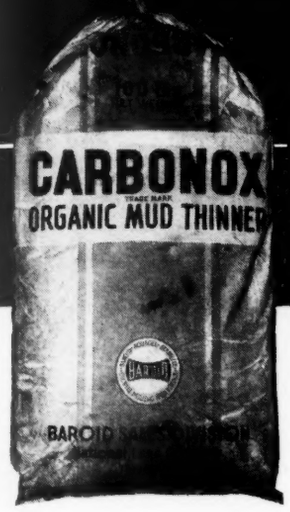
LARKIN PACKER CO., INC. ST. LOUIS, MO.

Baroid

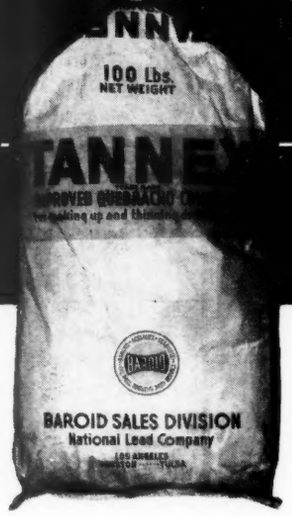


Non-Caking Organic Mud Thinners...

CARBONOX



TANNEX



PATENT LICENSES, unrestricted as to sources of supply of materials but on royalty basis, will be granted to oil-bearing companies and others desiring to practice the subject matter of any and/or all of United States Patents Nos. 2,041,086, 2,066,758, 2,066,316, 2,110,829, 2,296,877, 2,387,694, 2,393,165, 2,393,173, 2,417,307, and further improvements thereof. Applications for licenses should be made to Los Angeles office.

CARBONOX, Baroid's new organic mud thinner, provides an excellent means of thinning and reducing the gel strength of drilling muds. It may be used for the same purposes for which quebracho is used. Many operators use it successfully to treat normal *p*H muds, high *p*H Impermex muds, and high *p*H lime muds. CARBONOX requires less caustic soda than does quebracho to treat normal *p*H muds, the usual treatment being made in the proportion of 10 pounds of caustic soda to 50 pounds of CARBONOX. Muds treated with CARBONOX offer unusual resistance to contamination by salt water.

TANNEX is a full substitute for quebracho. It can be used wherever quebracho is used, and in exactly the same manner. Both compounds show continued mud thinning efficiency even when exposed to high bottom-hole temperatures. Neither of these powders, unlike quebracho, has any appreciable tendency to lump, cake, or turn hard, nor will spoilage occur in storage.

Baroid Sales Division, Department A-8
P.O. Box 2258, Terminal Annex, Los Angeles 54, Calif.

Send me detailed information on CARBONOX and TANNEX organic mud thinners.

NAME _____

COMPANY _____ TITLE _____

STREET _____

CITY _____ STATE _____

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NATIONAL LEAD COMPANY
LOS ANGELES 12 • TULSA 3 • HOUSTON 2

. . . run your strings with REPUBLIC ELECTRIC WELD CASING AND TUBING and ease your mind of worries. They are uniformly round, with electric resistance welded walls that are uniformly thick and strong. They bring you high ductility steel, fully normalized for uniform structure. Casing is cold sized to further increase its high yield strength.

With Republic Electric Weld Casing and Tubing on the job you'll enjoy relief from worries about pull-outs. Uniform roundness and wall thickness mean that threads are anchored solidly in a uniform depth of sound steel . . . leaving no trouble-inviting weak spots.

And, when the pressure is on to hurry the make-up, you'll appreciate the way those full-formed threads help speed stabbing, spinning and tonging. Make sure you get all three—resistance to pull-out, fast make-up, resistance to collapse—by specifying Republic Electric Weld Casing and Tubing.

REPUBLIC STEEL CORPORATION
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, N. Y.

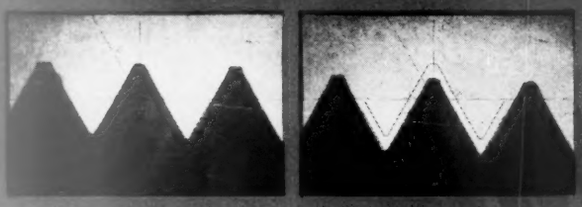
Republic Electric Weld Casing and Tubing are made from flat-rolled steel, both sides of which are inspected. Thus, the surface which becomes the inside wall is free from hidden defects.

REPUBLIC *Electric Weld*
NORMALIZED CASING AND TUBING

REPUBLIC STEEL

Other Republic Products include Line Pipe—Carbon, Alloy and Stainless Steels—Upson Studs, Bolts and Nuts—Electrunite Heat Exchanger Tubes

XUM



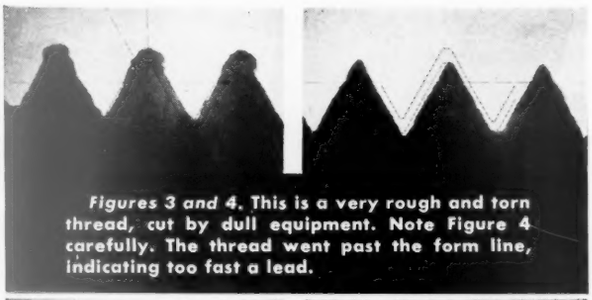
Figures 1 and 2. The above O-C-T precision thread was moved the exact distance of five threads. Note in Figure 2 how the thread exactly matches the lower form line, indicating both perfect lead and taper.

POSITIVE PROOF

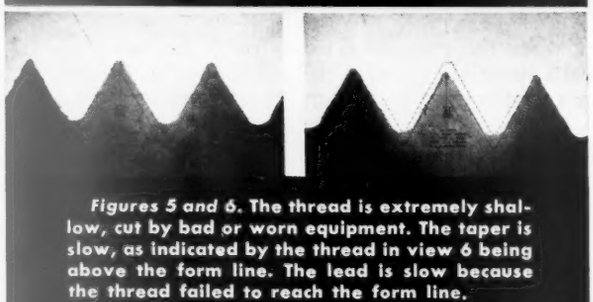
THAT O-C-T MAKES THE MOST PERFECT NIPPLE THREAD IN THE OIL FIELD TODAY

IMPARTIAL THREAD COMPARATOR TESTS ON COMPETITIVE NIPPLES SELECTED AT RANDOM FROM SUPPLY STORE STOCKS GIVE POSITIVE PROOF OF O-C-T SUPERIORITY

The comparator checks the lead and taper of threads by fitting a thread in the upper form line, then moving over the *exact* required distance for five threads, after which the thread should exactly fit the lower form line. Figures 1 and 2 show how the O-C-T precision thread lives up to this requirement. Figures 3, 4, 5 and 6 show examples of how stock nipples obtained from supply stores failed to meet the critical eye of the comparator.



Figures 3 and 4. This is a very rough and torn thread, cut by dull equipment. Note Figure 4 carefully. The thread went past the form line, indicating too fast a lead.



Figures 5 and 6. The thread is extremely shallow, cut by bad or worn equipment. The taper is slow, as indicated by the thread in view 6 being above the form line. The lead is slow because the thread failed to reach the form line.

Figure 7. This shows the results of screwing a thread of imperfect lead into a thread of proper lead. The result is contact on only one side of the thread and resultant leak space shown by white area.

Figure 8. The result of screwing a shallow bottom thread into a perfect thread. The shallow bottom prevents contact on the tapered side of the thread, resulting in the leak space shown by white area.

Here are the results of the comparator tests! Judge for yourself.

O-C-T Nipple threads are gauged in strict accordance with API inspection standard 5B. All O-C-T Nipples are cadmium plated. All O-C-T Nipples are carefully packaged to prevent damage in shipment, and sizes 2" and up are shipped with thread protectors.

Specify O-C-T Pipe Nipples and Fittings from your supply store. You'll get the finest quality in the oilfields today!

BE SURE TO MATCH O-C-T PRECISION THREAD NIPPLES WITH O-C-T FITTINGS

O-C-T Nipples in sizes 1" and smaller are made from SAE B 1113 bar stock. If special steel specification is desired to meet a specific installation, price and delivery will be furnished on application. Material specifications are subject to change as improved steels become available.

OIL CENTER

TOOL COMPANY

P. O. BOX 3091
HOUSTON, TEX.

Export Representative

Venezuela, Colombia, Peru and Ecuador:
Berry & Hall, Apartado No. 304, Maracaibo, Venezuela.

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to P. O. Box 3091, Houston 1, Texas.

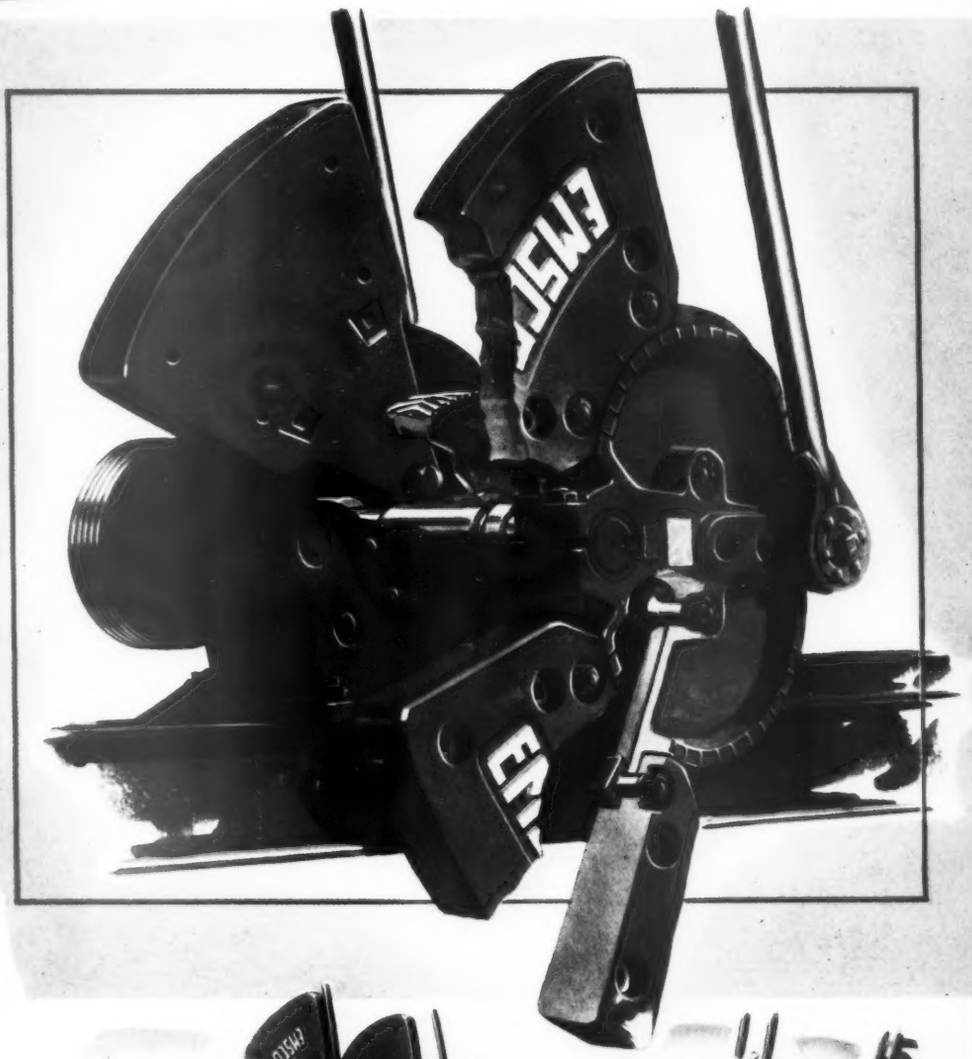
Perfect Counterbalancing

A ONE MAN OPERATION WITH EMSCO *PIVOTED* ROTARY COUNTERBALANCE PUMPING UNITS

Profitable pumping requires a perfectly counterbalanced pumping unit. Without it, both surface and subsurface equipment are subjected to dangerous stress reversals. Power consumption fluctuates and entire operation is inefficient. Emsco pumping units are equipped with a special *pivoted* rotary counterbalance. Its design permits precise adjustments to be easily made by one man working at ground level.

The counterbalance weights are pivoted from the crank arms. They are clamped to the semi-circular tracks. No load is carried on the inside faces of the tracks. This permits weights to move freely on the crank arms and allows quick, safe and accurate adjustments. Any effect, from zero to maximum, can be obtained.

Ask your nearest representative for complete information on Emsco pumping units. Available in standard and floor-clearing units for shallow, medium and deep pumping, with a range of speeds and strokes to meet all requirements.



Weights at zero effect. To adjust: stop unit with lower weights about 15° off vertical. Loosen clamping bolts and weight will swing to vertical position. Tighten clamping bolts.

Disengage service brake. The upper counterbalance weight will cause unit to swing clockwise. Stop unit when weight has swung about 15° past vertical. Loosen clamping bolts and weight will swing to vertical position. Tighten bolts.

Repeat operation until weights are swung into the desired position. When weights are pivoted as far as possible from low speed shaft, maximum counterbalance effect is obtained. Adjustment markers are provided to facilitate operation.

CONTINENTAL

THE CONTINENTAL SUPPLY COMPANY

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What's Your Pumping Problem?

Are your wells sanding up? Is high pressure gas or low gravity crude playing havoc with your production? Is corrosion causing abnormal wear and expensive pulling jobs and pump replacements? If you are troubled with these common pumping problems it will pay you to investigate D + B deep well pumps. For nearly a half century D + B has constantly directed its energies to the development of the finest pumping equipment to meet all subsurface conditions. Typical of D + B engineering achievements is the perfection of the new "Endurall" stainless steel pumps for extreme corrosive and abrasive service. Let a D + B representative show you how D + B pumps and sucker rods provide you more efficient and economical operation.

D+B

DEEP WELL PUMPS

"PACEMAKERS IN PRODUCTION EQUIPMENT DESIGN"

D+B DIVISION EMSCO DERRICK & EQUIPMENT COMPANY

Dallas, Texas ★ Los Angeles, California

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MISSION Extra-Long "Rolling-Dog" Rotary Hand Slips.

Power Slips Promote
Crew Efficiency

The heavy labor of handling the slips on round trips is eliminated. Men remain fresh through the tour. MISSION "Super-Speed" Power Slips are:

1. EASY TO INSTALL . . . merely bolted to foundation beams, and air connected.
2. EASY TO PUT ON PIPE . . . swing on like tongs.
3. EASY TO OPERATE . . . driller merely operates a pedal.
4. SAFE! . . . MISSION "Rolling Dogs" protect the pipe. Men are relieved of a dangerous task.

MISSION MANUFACTURING COMPANY

New York HOUSTON London

MISSION POWER SLIPS

. . . have a mission . . . to save you money!

G 203 B

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MISSION *long-lived*
"COMPOUND 308" INSERTS...

...give you 3 to 10 times normal service!

The MISSION "Compound 308"* Insert is one of our greatest achievements!

This insert lasts *3 to 5 times* as long as regular inserts, in ordinary mud . . . and *up to 10 times* as long as ordinary oil-resisting inserts, in hot mud, treated mud, or oil and gas.

Fits both our Silver Top Valve and our Super-Service Valve. Multiplies the time your pumps remain in operation between servicings. Available through all supply stores.

MISSION MANUFACTURING COMPANY

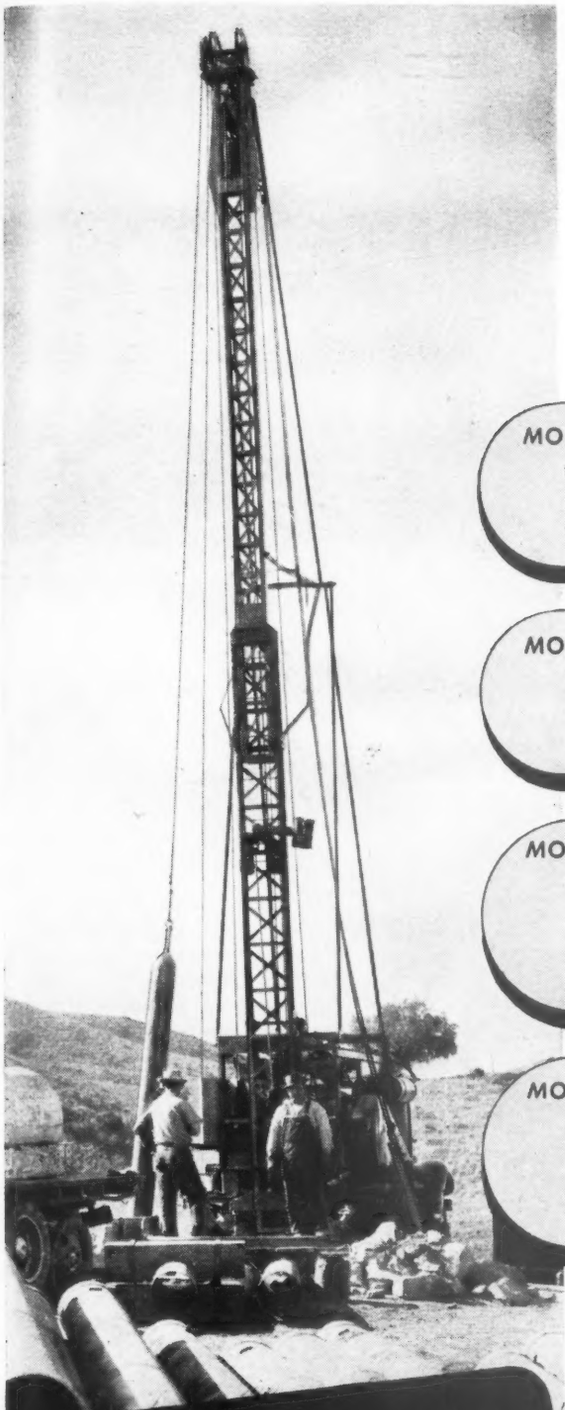
New York HOUSTON London

*TRADE MARK REG. U. S. PAT. OFF.

MISSION

G - 203 - A

More Ways for More Pay with Bucyrus-Erie SPUDDERS



All steel, big capacity Bucyrus-Erie rigs are giving smart contractors more jobs and more profits because they provide:

MORE mobility. Speedy mountings — trailer, semi-trailer, or skid — waste no time in getting your rig (all in one compact unit) from one location to another, enabling you to get the jump on every job.

MORE actual drilling time on the job. Quick rigging-up and tearing-down increases production; all steel, telescoping derricks are power raised; folding tubular braces move easily into place.

MORE footage put down per day. Snappy spudding motion obtained with the famous Bucyrus-Erie rubber shock absorber. Drilling is smooth, yet blows are of sharp, penetrating type for outstanding footage even in tough formations. The absorber can be blocked out for deep drilling.

MORE ease of operation. The convenient arrangement of controls on Bucyrus-Erie spudders saves time and puts you on top of your job at all times. Levers are easy to move. Big clutches and brakes give you the responses you need.

31547

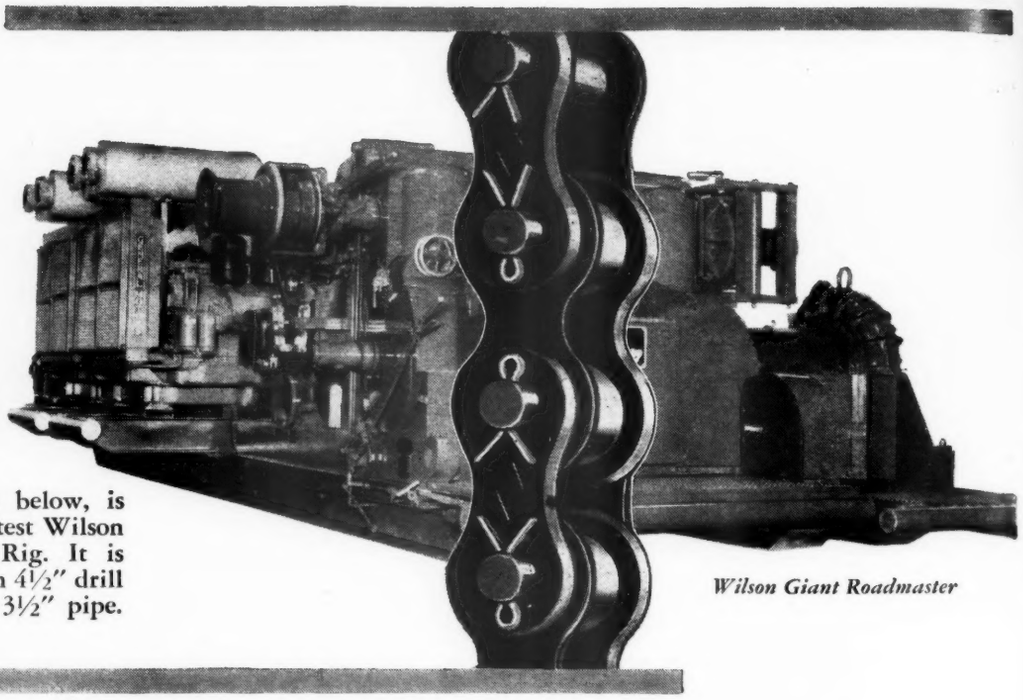
Bucyrus-Erie spudders can mean more jobs and profits to you too! Why not investigate models 48-L, 36-L, 28-L, and 24-L?

These features mean *MORE* versatility for handling all-round oil field work. Top-to-bottom drilling, tailing-in, cleaning out, deepening and other servicing jobs are all on the list of Bucyrus-Erie "payoff" operations.

BUCYRUS ERIE

SOUTH MILWAUKEE, WISCONSIN

On The Latest Wilson Rig



Wilson Giant Roadmaster

Bobby Burns of Wichita Falls, son of Lester T. Burns, the purchaser of the 1932 Model Wilson Rig shown below, is the owner of this latest Wilson Giant Roadmaster Rig. It is rated at 7500 ft. with 4½" drill pipe; 9000 ft. with 3½" pipe.

. . . As On This 1932 Model

This 1932 model, the second Wilson Drilling Rig built, owned by L. T. Burns.

As Mr. Aubrey A. Wilson writes, "Needless to say Diamond Roller Chains were used on the first Wilsons and are regularly used on the New Giant Roadmasters as well."

TRADE ◇ MARK

Now as Then . . . Equipped with . . .

DIAMOND ROLLER CHAINS

DIAMOND CHAIN COMPANY, INC.

Dept. 441, 402 Kentucky Ave., Indianapolis 7, Indiana
Tulsa Office: 2238 Terwilleger Blvd.

WHELAND SWIVELS

Now 4 SIZES

to meet every drilling need!

Specifications

E-6100 — 65 tons at 100 rpm
E-6200 — 131 tons at 100 rpm
E-6600 — 175 tons at 100 rpm
E-7000 — 232 tons at 100 rpm

EXPORT: Jones & Laughlin Supply Co. General Export Offices: 230 Park Ave., New York 17, N. Y., U.S.A. Wheland Export: Lucey Export Corp., 233 Broadway, New York 7, N. Y., U.S.A., and Broad Street House, E.C. 2, London, England.

. . . and there's something about a Wheland Swivel that makes Wheland users mighty loyal. Look into it! Write us at Tulsa today for Wheland Bulletin No. 173, or contact the Jones & Laughlin Supply store in your territory.

JONES & LAUGHLIN SUPPLY COMPANY

Stores and Offices in 17 States

Subsidiary of Jones & Laughlin Steel Corporation

General Office

TULSA, OKLAHOMA

J&L STEEL

PROVED AFTER 12 MONTHS

How the wear indicator works

When the blades are worn completely dull, the holding pin and plug are cut loose, releasing the drilling fluid. This causes a sudden drop in mud pump pressure, notifying the driller that the bit is dull and ready to change.

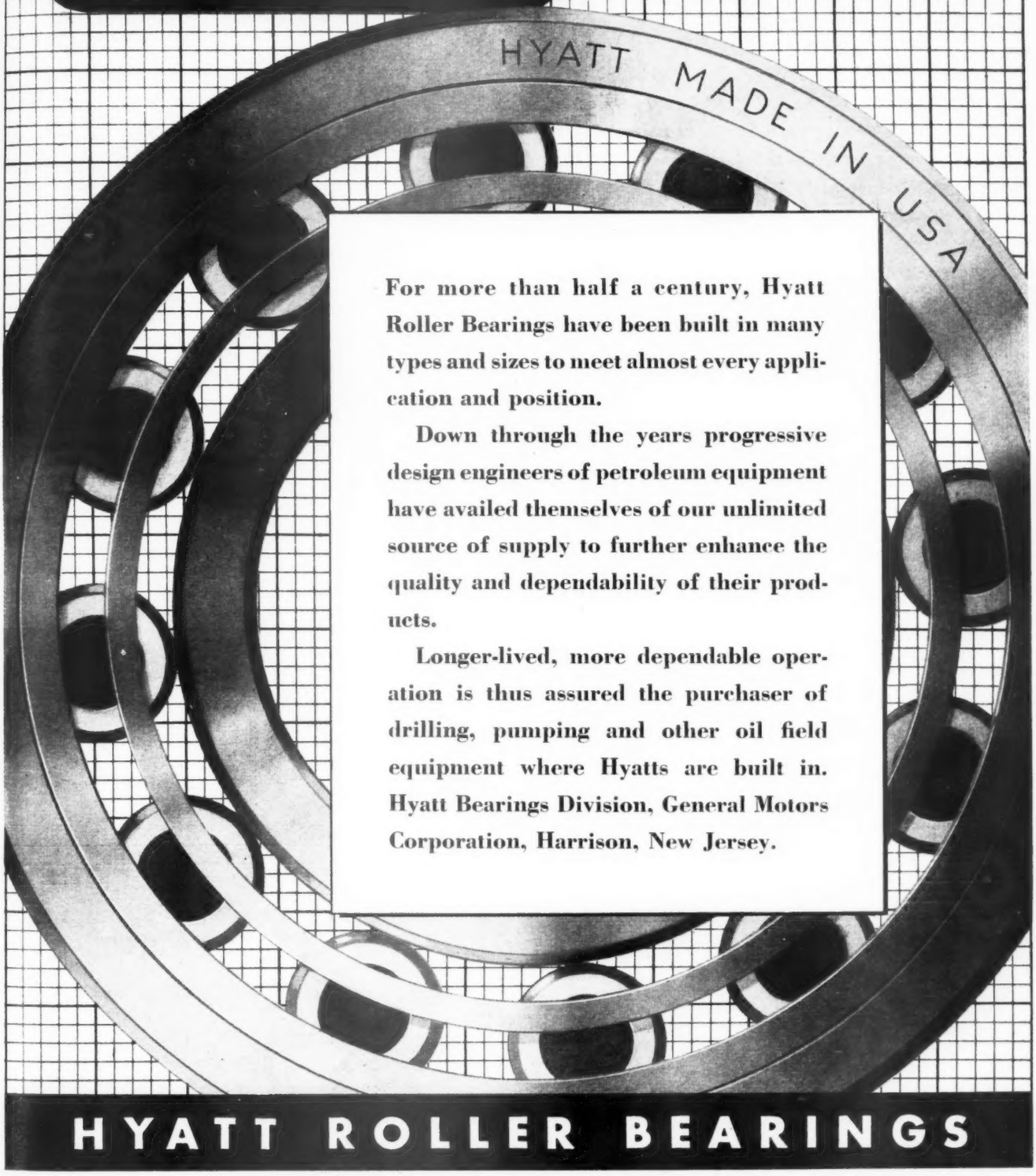
Replaceable tungsten carbide slush nozzle can be replaced in accordance with pump requirements. Note the streamlined fluid passage.

Reed **ROLLER BIT COMPANY**

HOUSTON 1, TEXAS

NEW YORK BUENOS AIRES LONDON

There were no Roller Bearings before Hyatt made them



For more than half a century, Hyatt Roller Bearings have been built in many types and sizes to meet almost every application and position.

Down through the years progressive design engineers of petroleum equipment have availed themselves of our unlimited source of supply to further enhance the quality and dependability of their products.

Longer-lived, more dependable operation is thus assured the purchaser of drilling, pumping and other oil field equipment where Hyatts are built in. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

HYATT ROLLER BEARINGS

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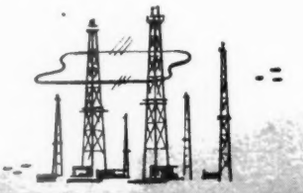
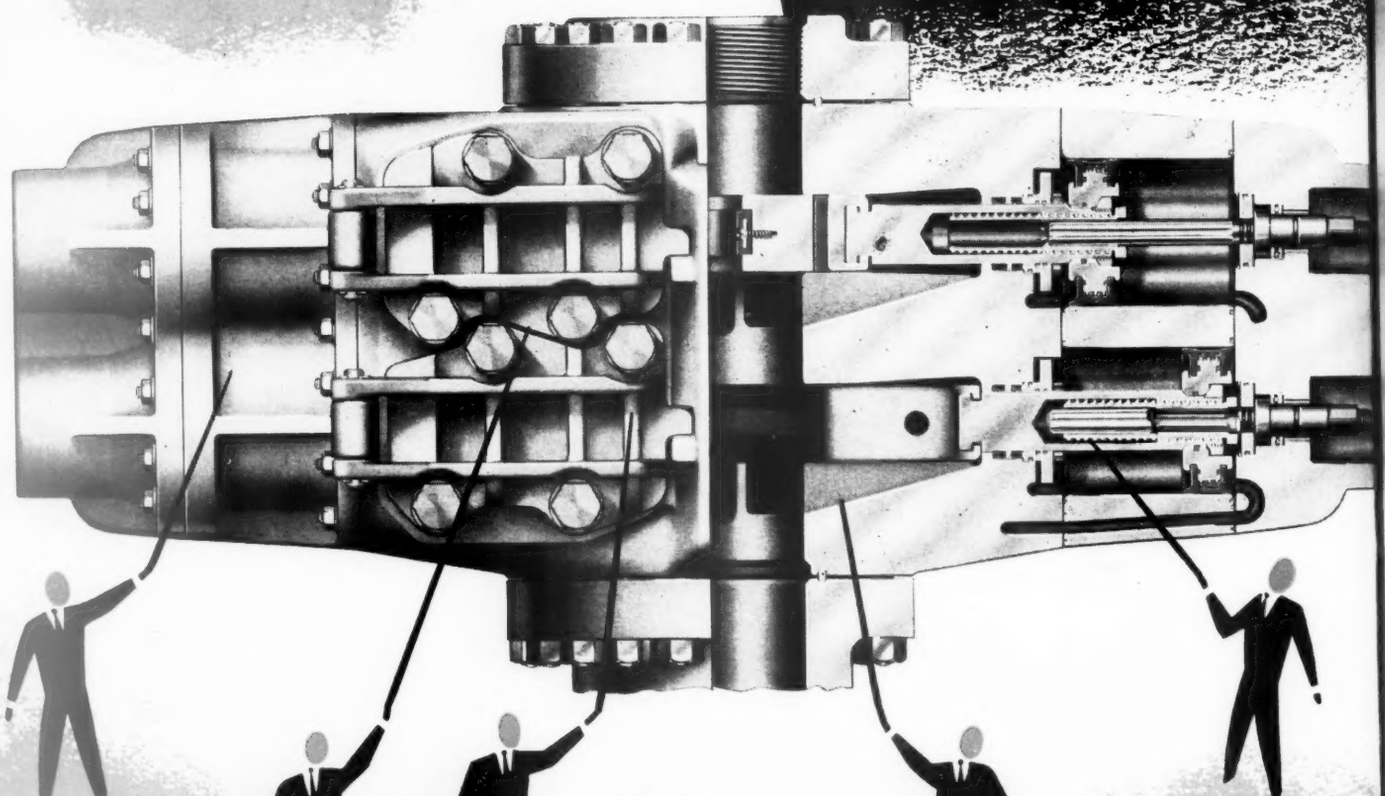
Announcing the greates



The SHAFFER Hydraulic CELLAR CONTROL GATE!

Here's what oil operators everywhere have been waiting for—a *Hydraulic* Cellar Control Gate that is COMPACT and COMPLETELY ENCLOSED . . . as well as simple to service, easy to install and extremely dependable. You get all these features—*and many more, too*—in the revolutionary new Shaffer Hydraulic Cellar Control Gate, the greatest control gate advancement in a decade.



UNUSUALLY COMPACT
A Double Gate measuring less than 30" in overall height, even in sizes as large as 13" . . . smaller sizes proportionately less!

TWO GATES IN ONE
Two separate ram compartments unitized into one compact body—actually two Hydraulic Gates in one!

FAST RAM CHANGES
Simply unbolt door on side of Gate, slide old ram out, change ram, slide ram back in, bolt door shut. It's as simple and fast as that . . . and complete ram changes can be made whether pipe is in or out of the hole!

QUICK-DRAINING BODY
Rams travel on narrow guide ribs high above a steeply-sloped self-draining ram compartment bottom. No detrimental sand or mud accumulation!

DIRECT HYDRAULIC DR
Fluid Power—Direct Action—Positive Operation! All moving parts protected within the body.

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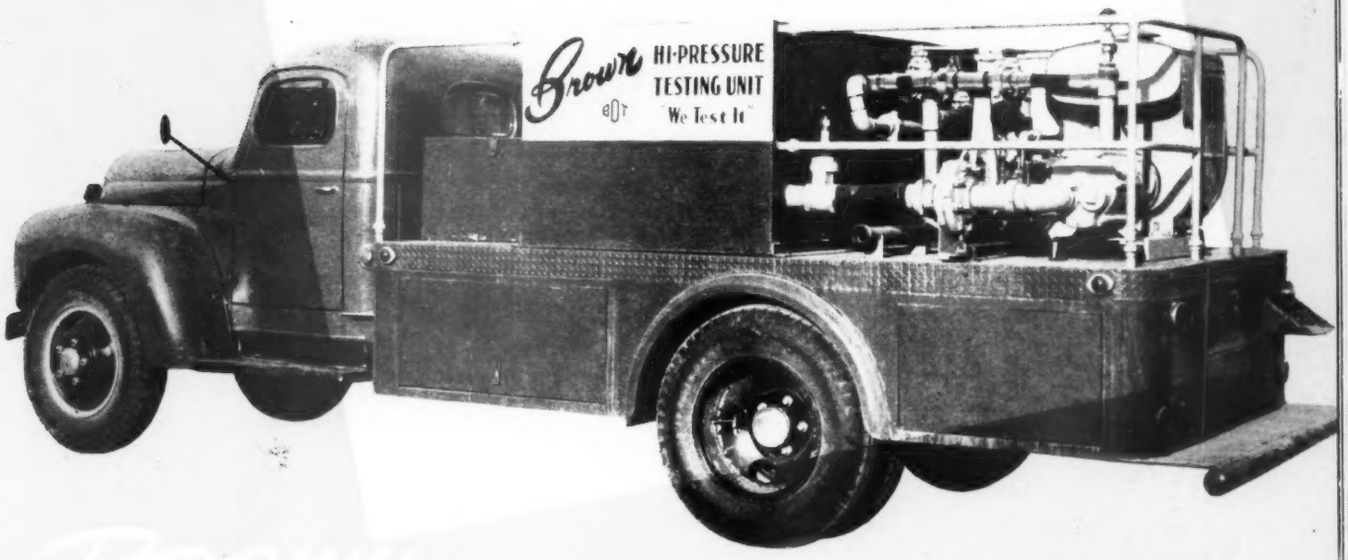
DON'T BE HALF SURE!



BROWN HYDROSTATIC TESTING UNIT

IS THE ONLY SURE WAY TO KNOW YOUR PIPE IS PRESSURE-SAFE

Don't guess and speculate about the condition of your pipe and pressure vessels. Be sure they will withstand the pressures at which they are to be used. Brown Hydrostatic Testing Unit gives you proof of their fitness for service, on the spot, quickly and economically.

This truck mounted unit, capable of developing 20,000 pounds pressure, can be brought to your location, and test your equipment at pressures as great or greater than service conditions.

The testing unit is equipped with a special control device, enabling the operator to pre-set testing pressure. It cannot develop more than this pre-set pressure, thereby eliminating the danger of applying undue stress to your equipment.

Water or other hydraulic testing medium is carried in the truck's own tanks. After filling and testing the equipment, the fluid is withdrawn into these same tanks, instead of being dumped.

Pipe can be tested on a truck, in the yard, on derrick racks or standing in the derrick. Quick change testing plugs eliminate danger of galling threads.

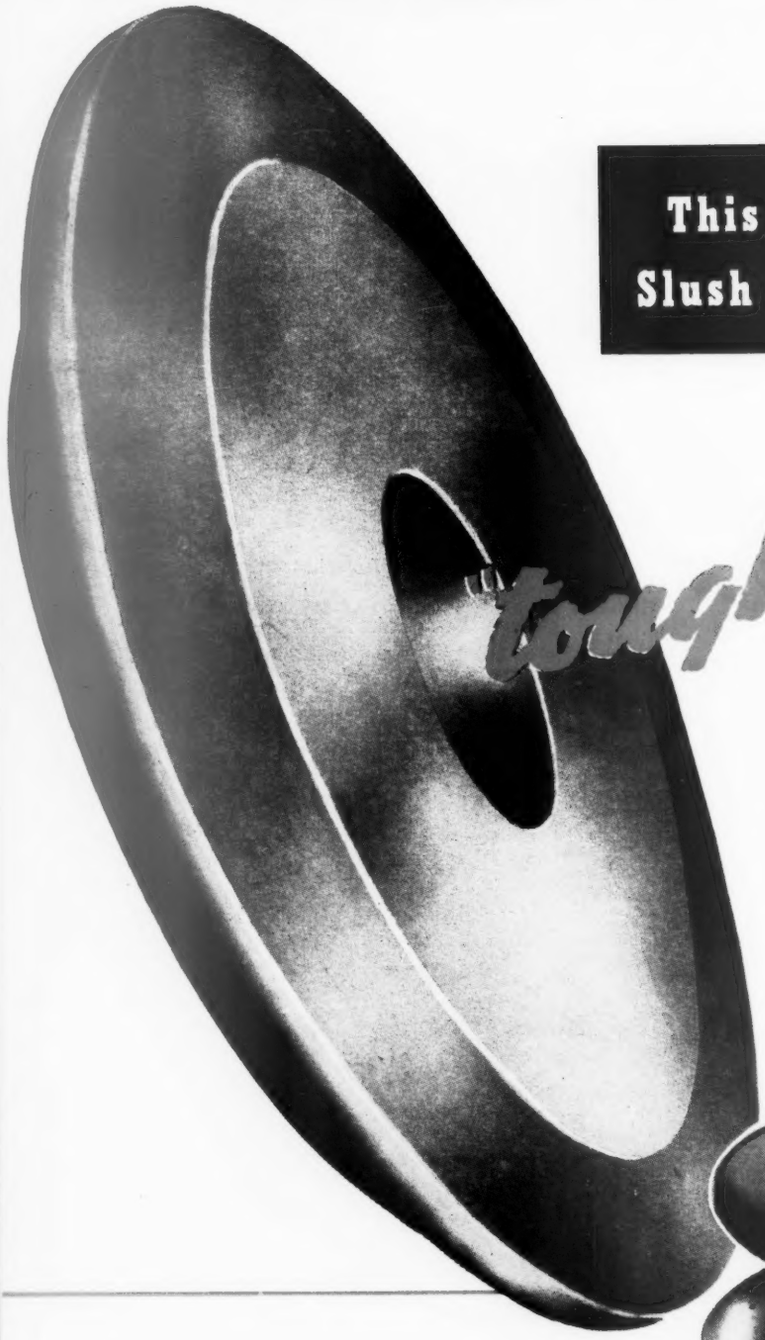
Don't be half sure . . . don't take chances. Have your pipe and pressure vessels hydrostatically tested with the BROWN HIGH PRESSURE TESTING UNIT and be sure they are safe for service.

BROWN OIL TOOLS, INC.

Sales Office: State National Bldg. Plant: 2200 Campbell St.

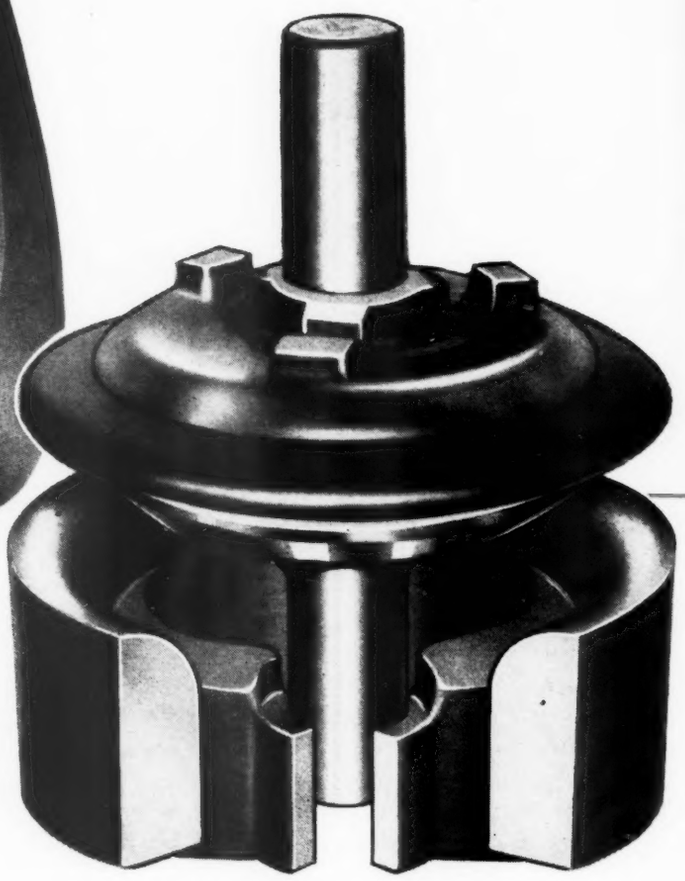
HOUSTON, TEXAS

EXPORT SALES: Acme Well Supply Co., 19 Rector St., New York, 6, N. Y.



This Murray Molded Midco Slush Pump Valve Insert is a

tough customer"



A slush pump valve insert must not swell or distort, must have high tensile strength and elasticity, must resist crude oil, gas, caustics and abrasion. In other words, it must be a "tough customer". And that is exactly what the Hendershot Valve Insert is.

Here, again, Murray's wide experience in compounding and molding Hycar oil-resistant rubber for the petroleum industry has paid-off for another equipment manufacturer.

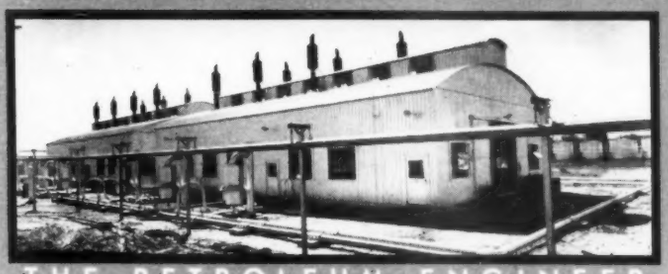
You, too, may find the solution to your rubber problems at Murray, where one of the nation's largest producers of mechanical rubber goods is augmented by complete engineering and machine shop facilities for the design and manufacture of customer's molds, dies, metal inserts and custom machine work.

MURRAY RUBBER CO.

HOUSTON TEXAS

Murray Rubber

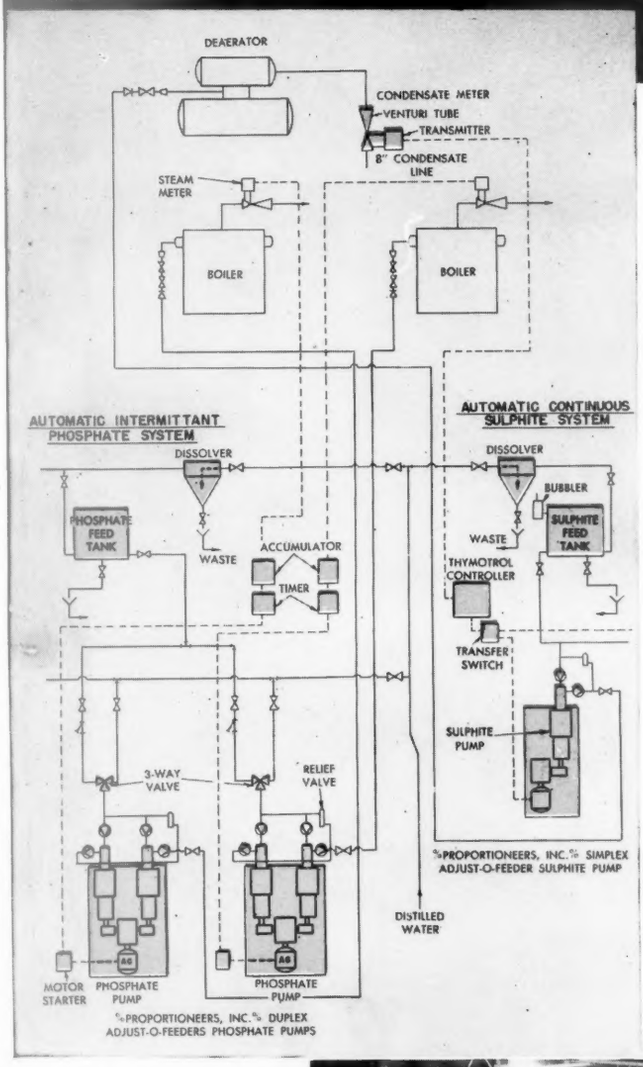
REFINING AND GAS PROCESSING SECTION



Process area of Slaughter gasoline plant described in this issue (Page A-35). Plant processes casinghead gas to extract butane, propane, and natural gasoline.

Standolind Oil and Gas Company Photo

Continuous-Automatic



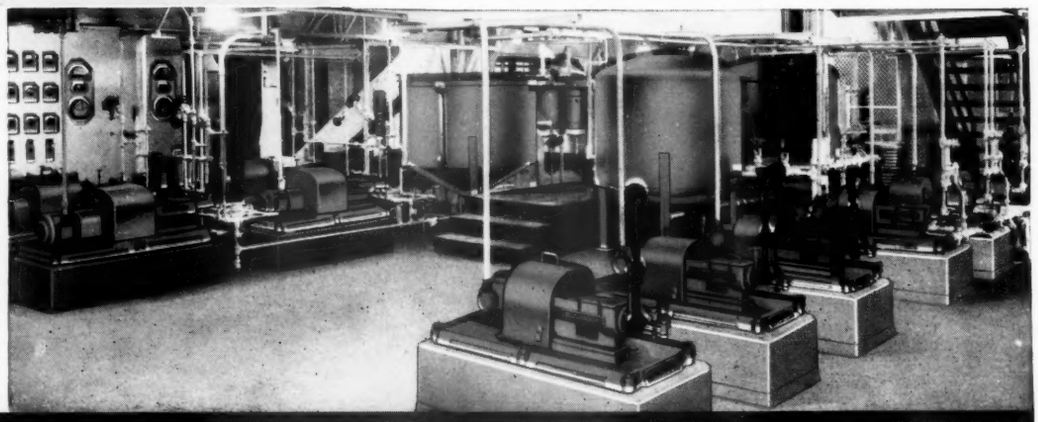
BOILER WATER CONDITIONING

%Proportioneers% boiler water treating equipment was selected for the new Redondo Steam Station of Southern California Edison Co. built by Stone & Webster Engineering Corporation in collaboration with Edison engineers. In this, one of the most modern plants in the world, the boilers are treated automatically and in proportion to their service load. The complete %Proportioneers% system makes chemical treatment a routine procedure, reducing operator responsibility. A necessity in large plants, the %Proportioneers% system is also highly desirable in small plants to reduce manpower and give adequate protection.

We furnish complete feeding systems to engineers' specifications or, where required, can adapt our controls to existing equipment. Ask for Brochure SM 122 "Treatment of Water for Boilers".

All equipment shown red in photo and flowgram furnished by %Proportioneers, Inc.%

%Proportioneers% sulphite feed pumps in the Redondo Steam Station, in foreground; high pressure duplex phosphate pumps and control panel, in the background.



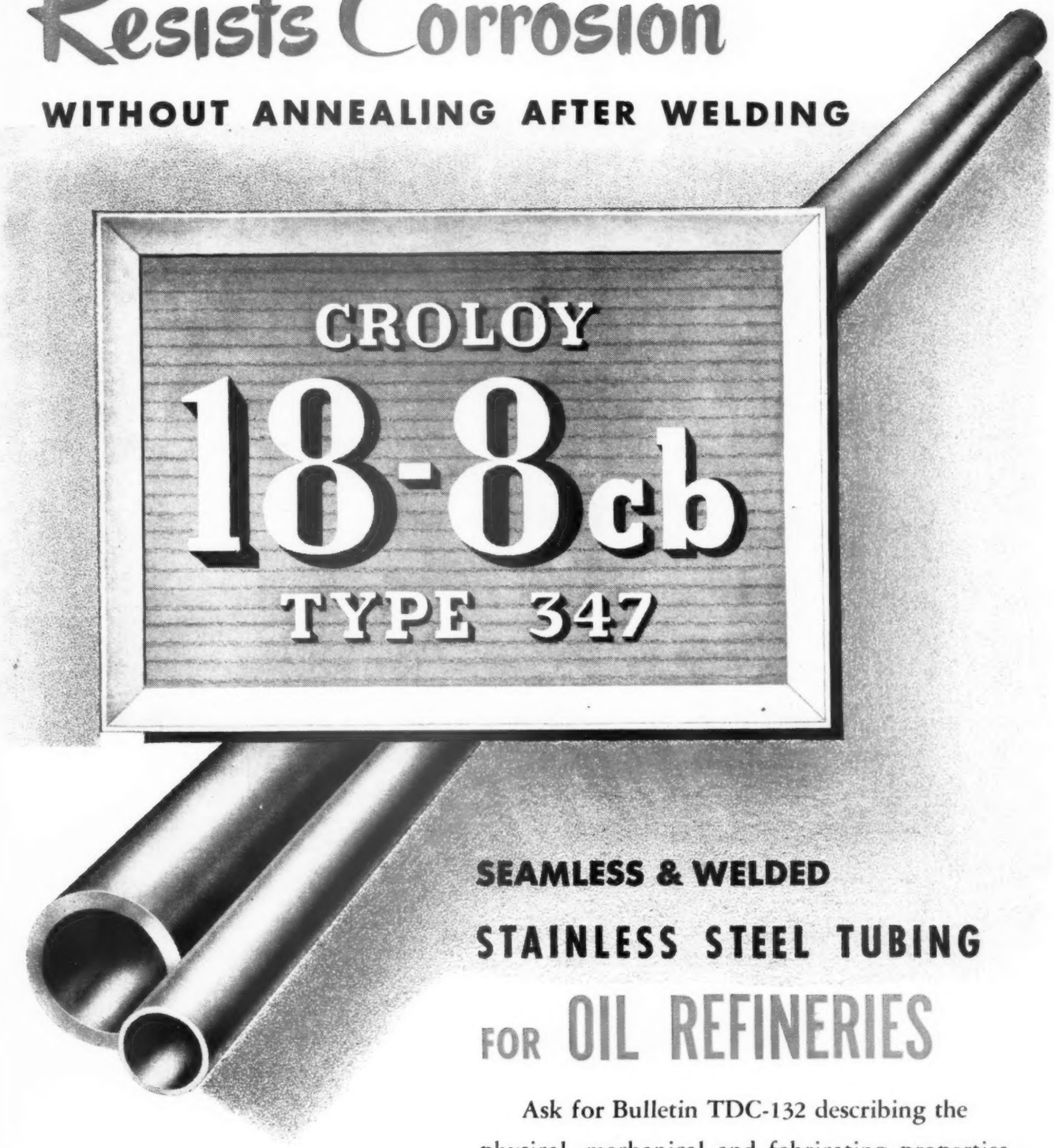
% PROPORTIONEERS, INC. %

Write to %Proportioneers, Inc.%, 28 Codding St., Providence 1, R. I.

Technical service representatives in principal cities of the United States, Canada, Mexico and other foreign countries.

Resists Corrosion

WITHOUT ANNEALING AFTER WELDING



SEAMLESS & WELDED

STAINLESS STEEL TUBING

FOR OIL REFINERIES

Ask for Bulletin TDC-132 describing the physical, mechanical and fabricating properties.

TA-1466-S

THE BABCOCK & WILCOX TUBE COMPANY
General Offices: Beaver Falls, Pa.
Plants: Beaver Falls, Pa., and Alliance, Ohio

BABCOCK & WILCOX SEAMLESS & WELDED TUBES

A full range of Stainless, Alloy and Carbon Steel Tubing for all Pressure and Mechanical Applications

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AUTOMATIC CONTROLLERS
Air-Operated
Cycle
Electric Contact
Humidity
Level
Pressure
Recording
Steam-Operated
Self-Operating
Temperature
Temperature-Time
Timers
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GAGES
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Differential Pressure
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Recording Pressure
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HYDROMETERS
Alcohol
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MOISTURE METERS
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Carbon Residue Apparatus
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Float Test Apparatus
Melting Point Apparatus
Penetration Apparatus
Ring and Ball Testers
Sampling, Measuring and Gauging Apparatus
Sulphur Determination Apparatus
Vapor Pressure Bombs
Viscosimeters
Water Determination Apparatus and Other ASTM Apparatus

PYROMETERS
Indicating—Single and Multiple Point
Indicating Controllers
Recording Controllers
Recorders—Single and Multiple Point

RECORDERS
Humidity
Motion
Pressure
Temperature
Vacuum

RECORDER CONTROLLERS
Humidity
Hydrogen Ion
Pressure
Temperature
Vacuum

RESISTANCE THERMOMETERS
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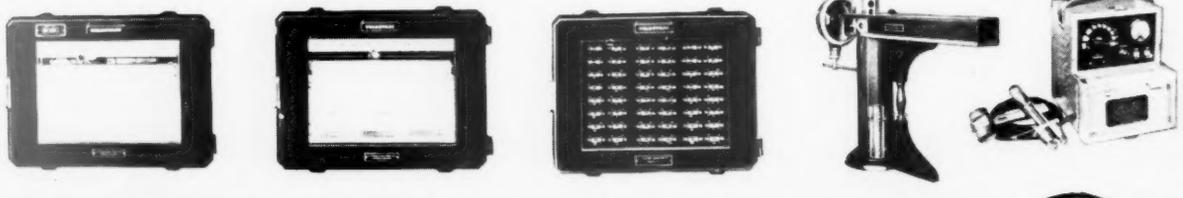
Indicating Controllers
Recorder Controllers
Recorders—Single and Multiple Point

THERMOMETERS
ASTM
Chemical
Dial
Etched Stem
Industrial
Laboratory
Paper Scale
Recording

VACUUM GAGES
Mercurial

VALVES
Diaphragm
Motor Operated
Reducing
Regulating

Whether the need is for instrumentation to be "designed-in" at the planning stage, or improved instruments for present equipment or processes, the answer will be found in the complete Tag line listed above. Check this list against your instrument requirements, and write to us for complete descriptive literature and prices.



C. J. TAGLIABUE CORPORATION (N. J.)

591 Frelinghuysen Avenue, Newark 5, N. J.

TAG

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Resourcefulness in plant design and construction originates from two main sources: First, the company's tangible strengths . . . laboratory facilities, engineering organization, manufacturing and construction equipment. Second, the capabilities of the *people* within the company organization in facing problems that require ingenuity and innovation.

These two company resources working together give maximum performance, for the resourceful man can accomplish no more than his tools and techniques permit.

Lummus offers you the resourcefulness that comes from complete facilities at the disposal of minds with originality and broad experience.

Economy
Fulfillment
Perspective
Teamwork

LUMMUS designs and builds with **RESOURCEFULNESS**

Technique

RESOURCEFULNESS in construction

Completion of this essential wartime plant faced a seemingly "unavoidable" delay:—the nation's entire shop capacity for tower and tank construction was already fully booked for equally essential work. Lummus met the emergency by building a complete pressure vessel shop on the site. Here, using modern time-saving methods such as automatic welding, towers and tanks for this and other vital war plants were fabricated on schedule.

RESOURCEFULNESS in planning

The problem here was to boost the capacity of a 10,000 B/D topping unit to 25,000 B/D without a serious break in output. By ingenious advance planning, the change-over was made with *only 72 hours downtime*. Nor was it just a "lucky accident"—for Lummus had assumed responsibility in its contract for this 72-hour time limit.

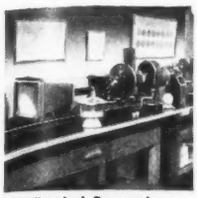
RESOURCEFULNESS in training

To erect this refinery in an isolated foreign location, local native labor was the only practical labor supply. Yet most of these people had never held a tool or even seen a welding torch. Lummus sent supervisors and foremen picked for their training aptitudes, backed them up with modern visual-education methods, organized a training school. "Graduates" were ready to meet erection schedules. Quality of workmanship met every test.

THE LUMMUS COMPANY
420 Lexington Avenue, New York 17, N. Y.

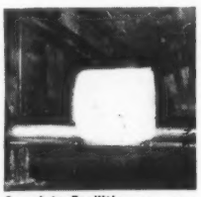
LUMMUS

CHICAGO—600 South Michigan Avenue, Chicago 5, Ill.
HOUSTON—Mellie Esperson Bldg., Houston 2, Texas
The Lummus Company, Ltd., 525 Oxford St., London, W-1, England
Société Française des Techniques Lummus
39 Rue Cambon, Paris 1er, France
Compañía Anónima Venezolana Lummus—Edifico "Las Gradillas"
Esquina Las Gradillas, Caracas, Venezuela



Metallurgical Research conducted continually by recognized specialists who have made major contributions in this field.

Unique Technical Backing of an extensive organization with an international reputation in both process and fabrication engineering.

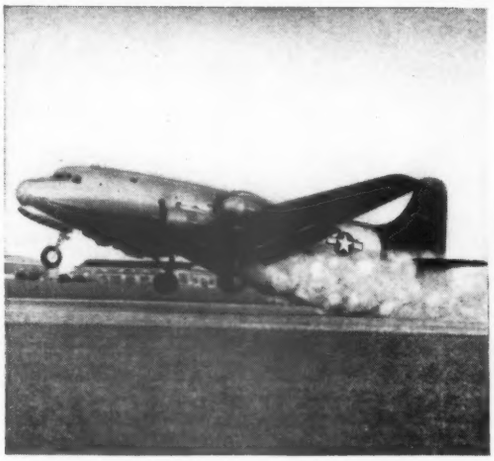


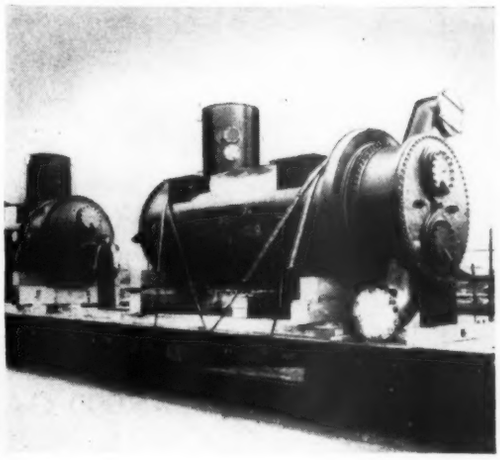
Complete Facilities for the fabrication of steel products from simple forgings to the most intricate 120 foot towers.

Top Welding Performance assured by specially designed equipment and exclusive employment of master operators.

Quality Control embracing the constant application of the most advanced inspection methods, both visual and non-destructive.

On-Time Delivery made possible by a flexible planning group authorized to re-route work to meet promised dates.





What do these four have in common?

It is the common denominator of this broad grouping that means something to you—the problem of heat exchange under varying conditions.

Take the Oak Ridge job. It was colossal in size and concept. But it was also outstanding because it included both processing of one of the most corrosive agents known (uranium hexafluoride) and the elimination of any possibility for contamination of the product. Kellex—Kellogg subsidiary—designed the heat exchangers.

What about rocket engines? Operating temperatures up to 6000°F in the combustion chamber with the concurrent limitation of the radically lower temperatures that both containing metals and volatile coolants can withstand, *plus* minimum weight requirements, *plus* use of highly corrosive cooling substances . . . those "specs" truly add up to a major heat exchange problem. Kellogg continues to design and fabricate these newest power units.

You, of course, are familiar with refinery heat exchange requirements: high throughput and low maintenance. The requirements for marine condensers are also exacting in that breakdowns while in use cannot be tolerated. Kellogg fabricates these types by the shipload.

Next time you are ordering heat exchangers remember that Kellogg is one place in the country where you can get all this design and fabricating experience, in the field of heat exchange, *under one roof.* And remember too that Kellogg is continuing its exploratory work in atomic energy . . . expanding rapidly in the field of jet propulsion . . . continuing to improve its refinery exchangers . . . working on other types—all with the goal of lower costs, lower maintenance and higher efficiencies.

To master temperature, pressure and chemicals use

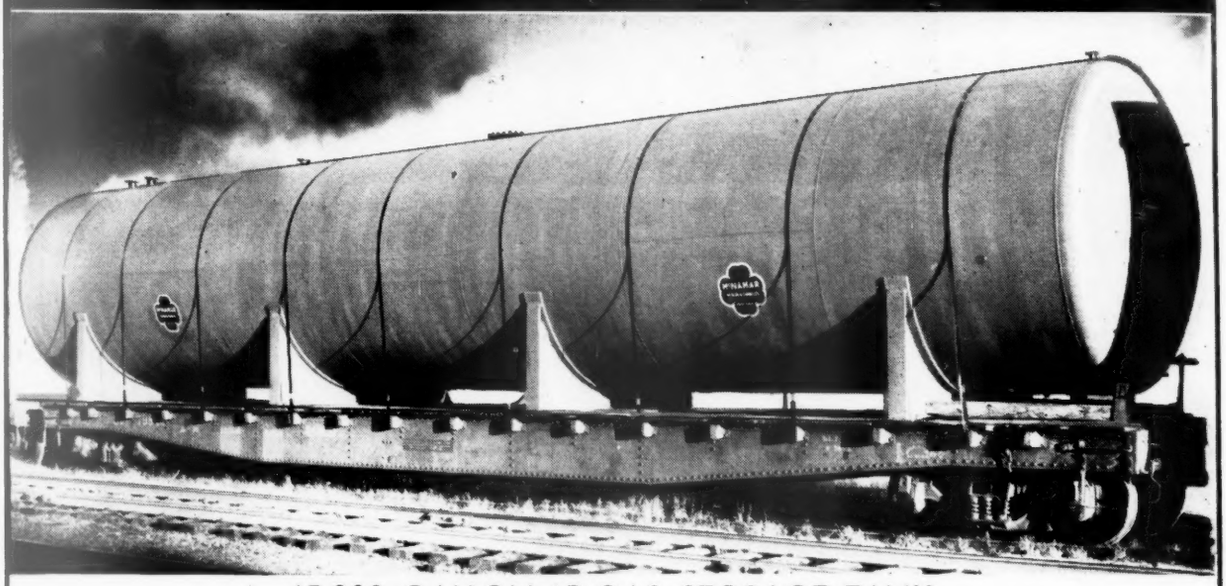
M. W. KELLOGG

process equipment

VESSELS • EXCHANGERS • CONDENSERS • HIGH PRESSURE AND HIGH TEMPERATURE POWER PIPING PROCESS PIPING • FORGED AND WELDED FITTINGS . . . IN ALL STEELS, ALLOYS OR SPECIAL COMBINATIONS

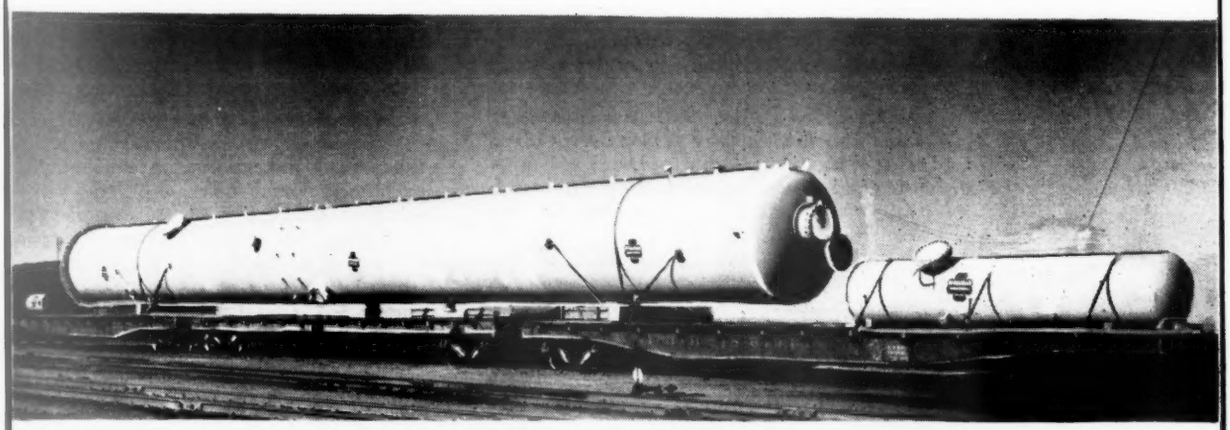
The M. W. Kellogg Company, Inc. (A Subsidiary of Pullman, Inc.) — Offices in New York, Jersey City, Buffalo, Los Angeles, Tulsa, Houston, Toronto, London and Paris.

STORAGE VESSELS now a * production line item at McNamar



45,000 GALLON LP-GAS STORAGE TANK

McNAMAR HAS INCREASED PLANT SPACE BY 30,000 SQ. FEET FOR THE EXCLUSIVE FABRICATION OF STORAGE VESSELS!



MAIN FRACTIONATING COLUMN ON 3 CARS ENROUTE TO CUSTOMER

- ★ REFINERY TOWERS
- ★ STORAGE TANKS
- ★ HEAT EXCHANGERS
- ★ ACCUMULATORS
- ★ STRUCTURAL SHAPES
- ★ MISC. REFINERY VESSELS

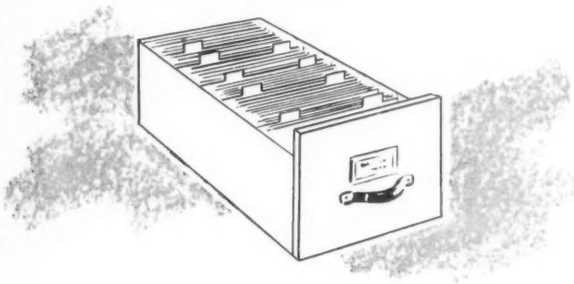
● GLAD TO FURNISH QUOTATIONS PROMPTLY ●

McNAMAR BOILER & TANK CO.

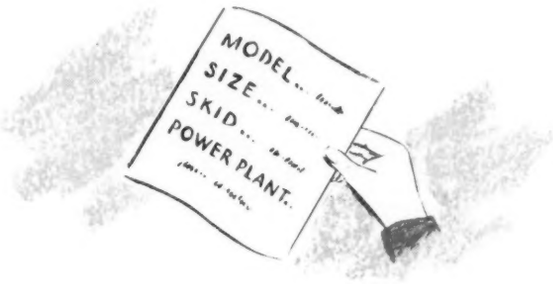
REFINERY SALES DIV.
BOX 868
TULSA, OKLA.

PIPE LINE AND MARINE TRANSPORTATION SECTION

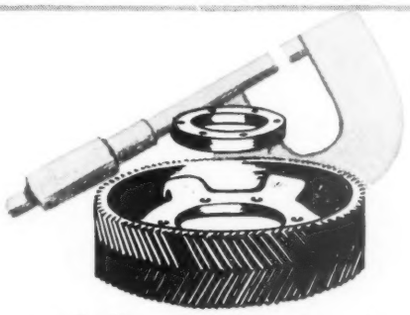
THE PETROLEUM ENGINEER



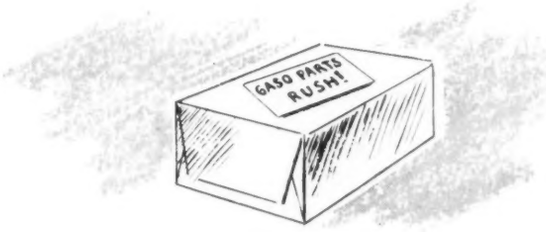
Complete detailed records



of all Gaso units



+ carefully maintained stocks of precision fitted parts



+ a policy of immediate shipment

= the utmost in pump parts service

Simple Arithmetic

ADDS UP TO-

GASO PUMPS

for every oil industry need

GASO PUMP & BURNER MFG. CO.

TULSA OKLAHOMA, U. S. A.

Export Office: 149 Broadway, New York. Shreveport and Odessa: W. L. Somner Co.
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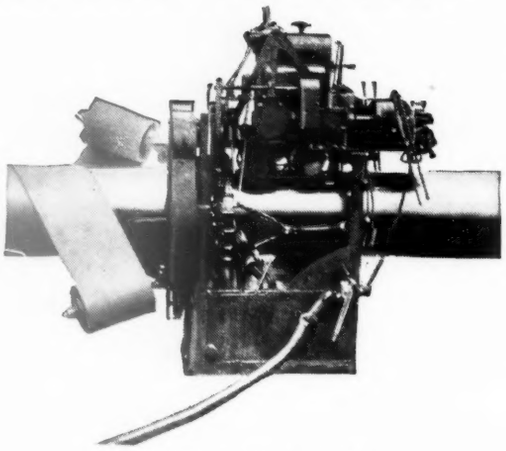
Barrett* PROTECTION SERVICE

Covers Every Pipe-coating Need

Materials and Application Procedure for:

1. Water Industries
2. Natural Gas, Crude Oils and Products Transmission
3. Professional Application in Plants and Yards
4. Distribution Systems
5. Reconditioning Operations
6. Gathering Systems
7. Recycling Operations

Materials and Application Procedure for NATURAL GAS, CRUDE OILS AND PRODUCTS TRANSMISSION



This machine is applying Barrett Pipeline Enamel and wrapping asbestos felt.

Because of the variable weather conditions under which enamel is applied to pipe, it is necessary to have a *weatherized* primer.

Most primers are designed to dry under normal conditions (50% humidity at 70°F) during 9 months of the year, but Barrett also makes special primers for use in very cold and very hot application weather.

These primers form lasting bonds with all Barrett* Enamels. Thus the line engineer is offered a wide range of primer-enamel combinations to suit his particular construction conditions.

The application of hot enamel over the primer *re-softens* the primer, and causes it to fuse with both the metal and the enamel for a perfect bond.

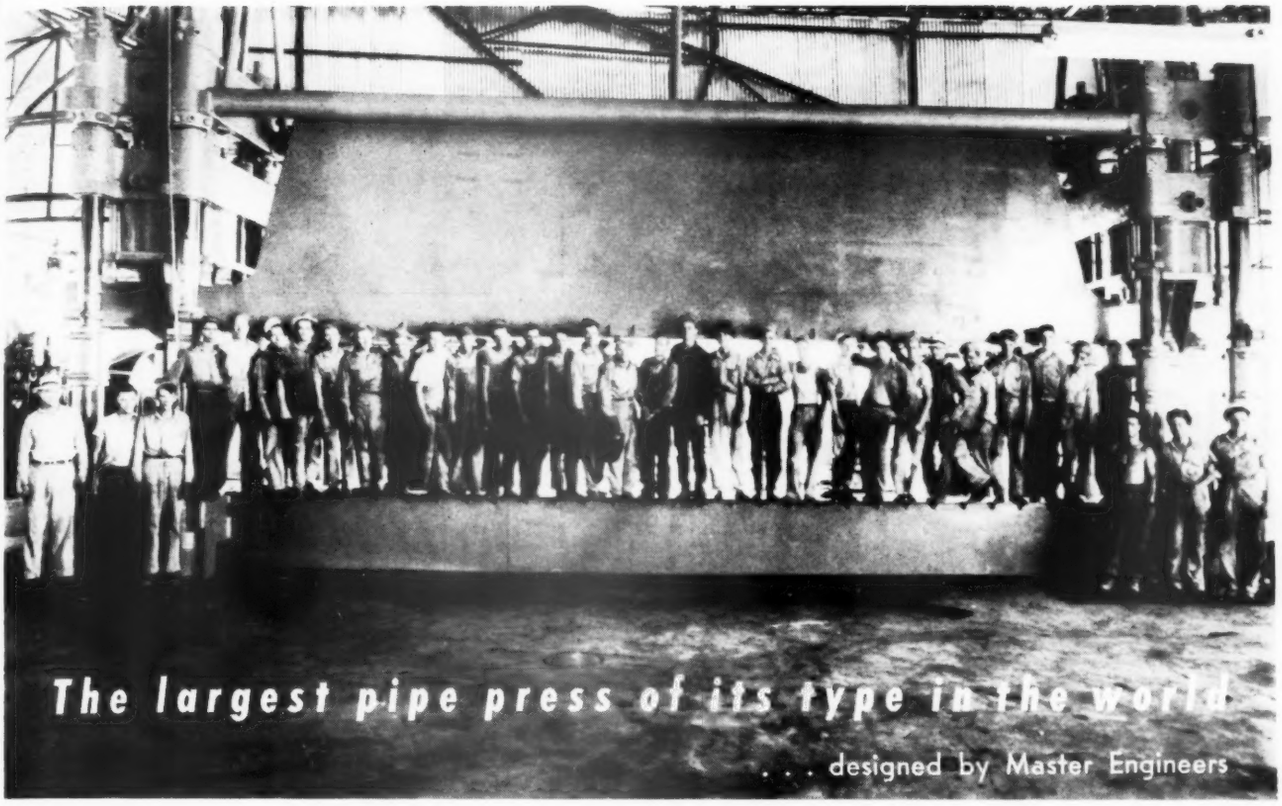
The initial and sustained dielectric values of Barrett enamels remain unchanged under all normal line currents. Since these values do not break down under electric currents put on the pipe, the economy of cathodic protection is assured.

The Barrett organization will be glad to confer with you on any of your pipe coating problems.

THE BARRETT DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.

*Reg. U. S. Pat. Off.

Barrett*



"Tooled-Up" FOR PIPE PRODUCTION

SOLVE YOUR PIPE PROBLEMS by calling on Master Tank & Welding. Our large modern plant has the finest and most modern equipment to do a better pipe fabricating job for you. Pipe sizes range from 10¾" to 30" diameter in 30-foot sections. Larger pipe is available in 18-foot lengths, double-jointed sections for 36-foot requirements.

OVER A MILE OF PIPE A DAY . . . is our present production and it is increasing every month. Our capacity is many times today's figure.

VISIT OUR PLANT and let's discuss your pipe problems. If you can't come to Dallas, write, wire or phone your requirements. We will furnish recommendations and quotations without obligation.

MASTER TANK & WELDING

MASTER GAS SYSTEM — MFG. BY MASTER TANK & WELDING

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HERE'S HOW NEW, BETTER "COROMAT"

THE IMPROVED UNDERGROUND PIPE WRAP

CUTS COSTS FOR YOU

Your wrapping crews can apply this new stronger "Coromat*" the improved underground pipe wrap *faster* . . . as much as 150% faster. And with practically a zero incidence of breaks in each 400-foot, 800-foot or 1200-foot roll . . . that means less starting and stopping of wrapping machines and less patch-work resulting from such stops. The new "Coromat" is almost 300% stronger than ordinary glass-type pipe wrap material, has specially designed glass-yarn reinforcing that vastly increases resistance to transverse tear.

And you still get all the cost advantages that you have been getting with the previous Fiberglas* Underground Pipe Wrap made by Owens-Corning . . . greater penetration of the wrap by the bitumen, lighter weight than any organic pipe wrap of comparable properties, complete freedom of the glass-mat wrap from rotting, complete inertness to the bitumen coating, and maximum reinforcing of the bitumen coating by the strong glass fibers and yarns that form "Coromat".

"Coromat" is the newest product of Owens-Corning Fiberglas research and engineering, has been tested in the lab and in the field. *Write today* for free samples of "Coromat" and a copy of the technical book "Corrosion Control for Underground Pipe". Write to OWENS-CORNING FIBERGLAS CORPORATION, Dept. 943, Toledo 1, Ohio. Sales offices in 27 leading cities.

FREE SAMPLE

FREE BOOK

OWENS-CORNING
FIBERGLAS
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"COROMAT" PIPE WRAP

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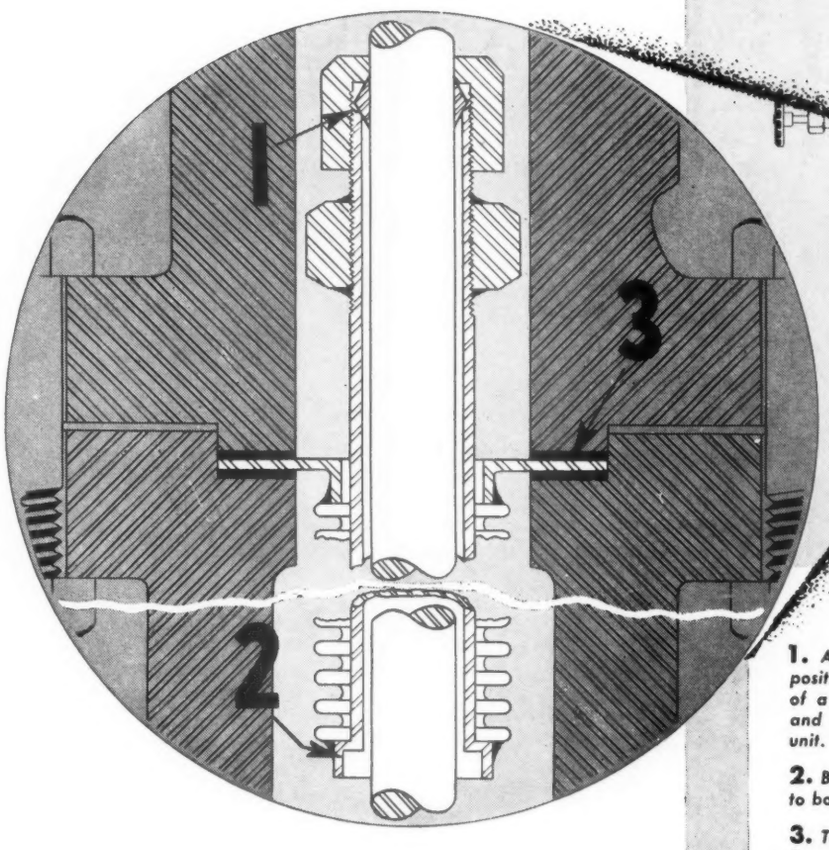
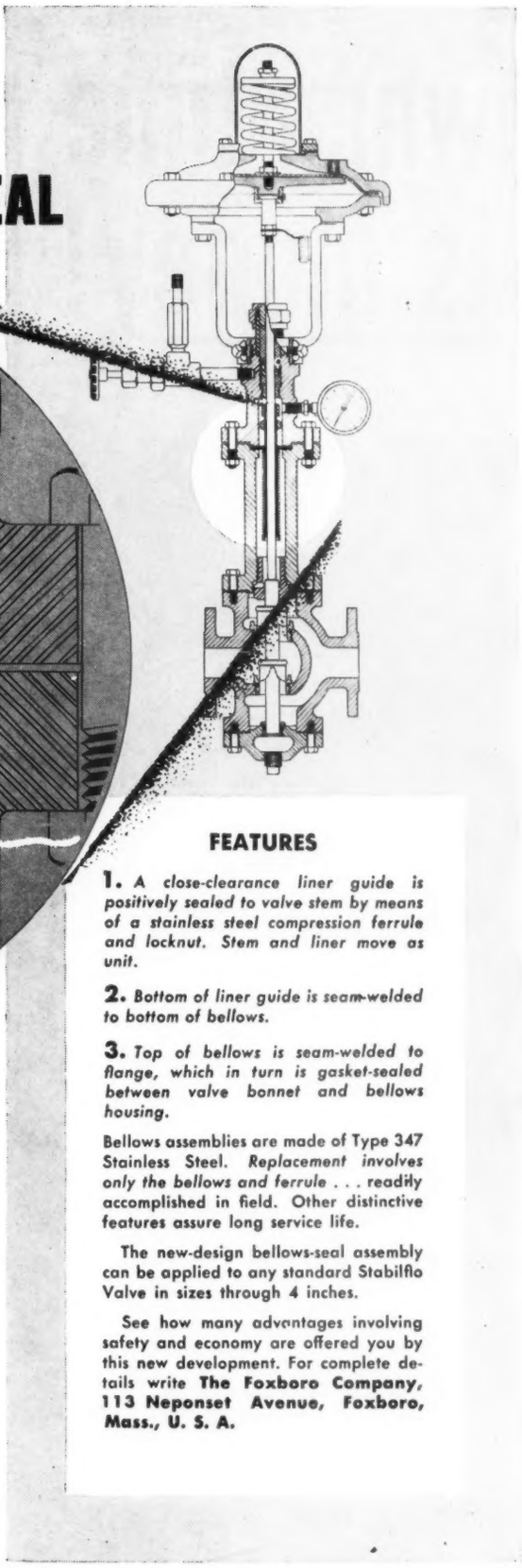
NOW! Stabilflo Valves with NEW, POSITIVE BELLOWS-SEAL





● Here's an automatic process control valve with a positive, safe, yet *simply-constructed* seal . . . for use wherever toxic, corrosive or precious fluids are involved. The Foxboro Stabilflo Valve is now available with a new-design, bellows-sealed valve stem. Instead of the conventional stuffing box, the packless bellows assembly makes a positive seal between the valve stem and valve body. The bellows expands and contracts with reciprocating action of valve stem.

Over the past eight years, Foxboro has pioneered in the development and application of bellows-sealed control valves for *special* jobs. This improved design is the outcome! It removes bellows-sealed valves from the class of "specials" because of its unique simplicity.

FEATURES

1. *A close-clearance liner guide is positively sealed to valve stem by means of a stainless steel compression ferrule and locknut. Stem and liner move as unit.*

2. *Bottom of liner guide is seam-welded to bottom of bellows.*

3. *Top of bellows is seam-welded to flange, which in turn is gasket-sealed between valve bonnet and bellows housing.*

Bellows assemblies are made of Type 347 Stainless Steel. *Replacement involves only the bellows and ferrule . . .* readily accomplished in field. Other distinctive features assure long service life.

The new-design bellows-seal assembly can be applied to any standard Stabilflo Valve in sizes through 4 inches.

See how many advantages involving safety and economy are offered you by this new development. For complete details write **The Foxboro Company, 113 Neponset Avenue, Foxboro, Mass., U. S. A.**

FOXBORO REG. U. S. PAT. OFF. **INSTRUMENTATION**

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for DEPENDABLE low cost

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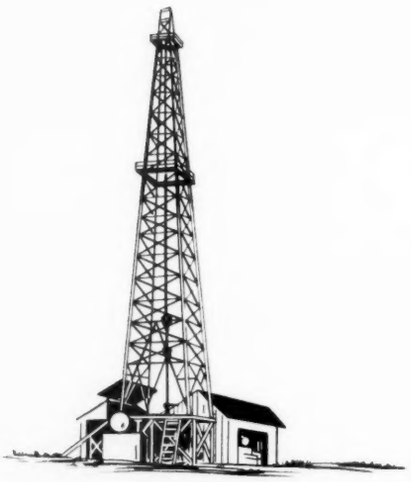
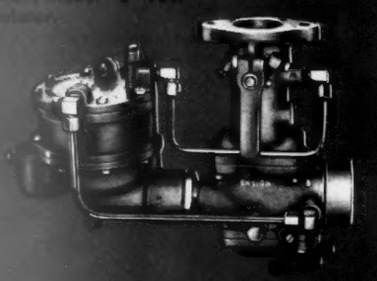
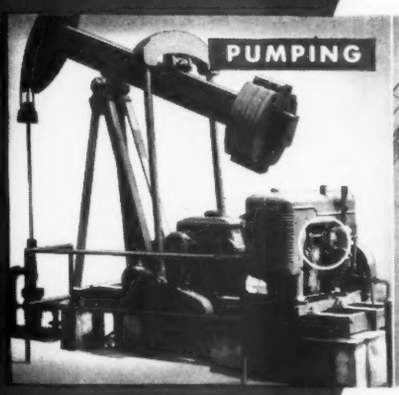
With every well drilling operation boiled down to a split second, there's little excuse for an unscheduled shut-down due to drilling failures. Gas engines provide DEPENDABLE and ECONOMICAL 24 hour service with the least maintenance. Good performance depends largely upon the carburetion, which in the case of over 90% of oil gas engines is ENSIGN. Over 38 years of carburetor experience are designed into simple and rugged Ensign models used on todays engines. Operators everywhere have learned to count on gas engines equipped with ENSIGN.

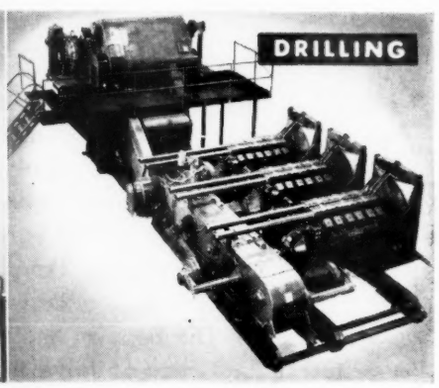


ENSIGN Model "Kgnl" combination Carburetor for use with Natural Gas, Butane-Propane or Gasoline.

ENSIGN Model "Kgnl" Straight Gas Carburetor for either Natural Gas or Butane-Propane and ENSIGN Model "S" Fuel Regulator.







Easy to start and easy to control on either Natural Gas, Butane-Propane or Gasoline, ENSIGN offers a proven unit. It matters little the type of engine: Slow speed single cylinder or the high speed multi-cylinder, ENSIGN is proved and accepted the world over for the best all around performance and dependability.

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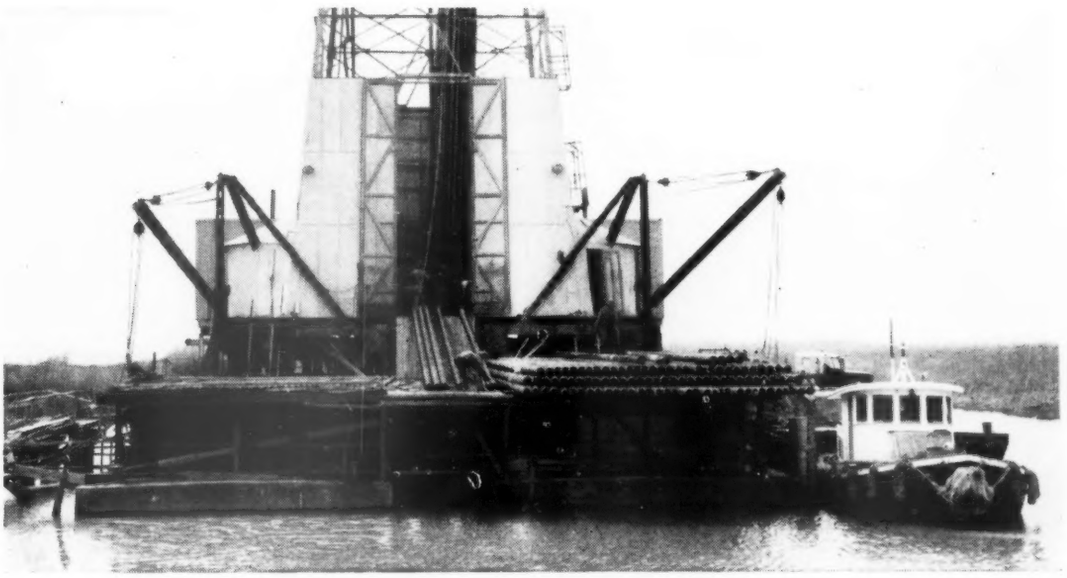
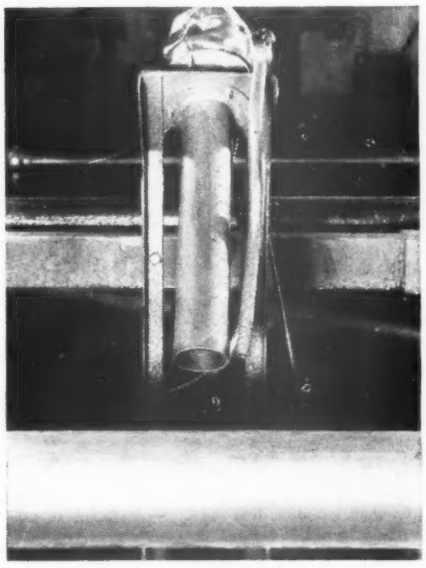
DEPENDABILITY THROUGH



IN A SOUTHERN FIELD: A 10,000-foot string of 7-inch S-80 and S-105 SMITHway Casing being run in the bayous of Louisiana.

RESEARCH AND ENGINEERING



IN THE A. O. SMITH PIPE MILL: This equipment is used for measuring and controlling Casing temperature for certain manufacturing processes.

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